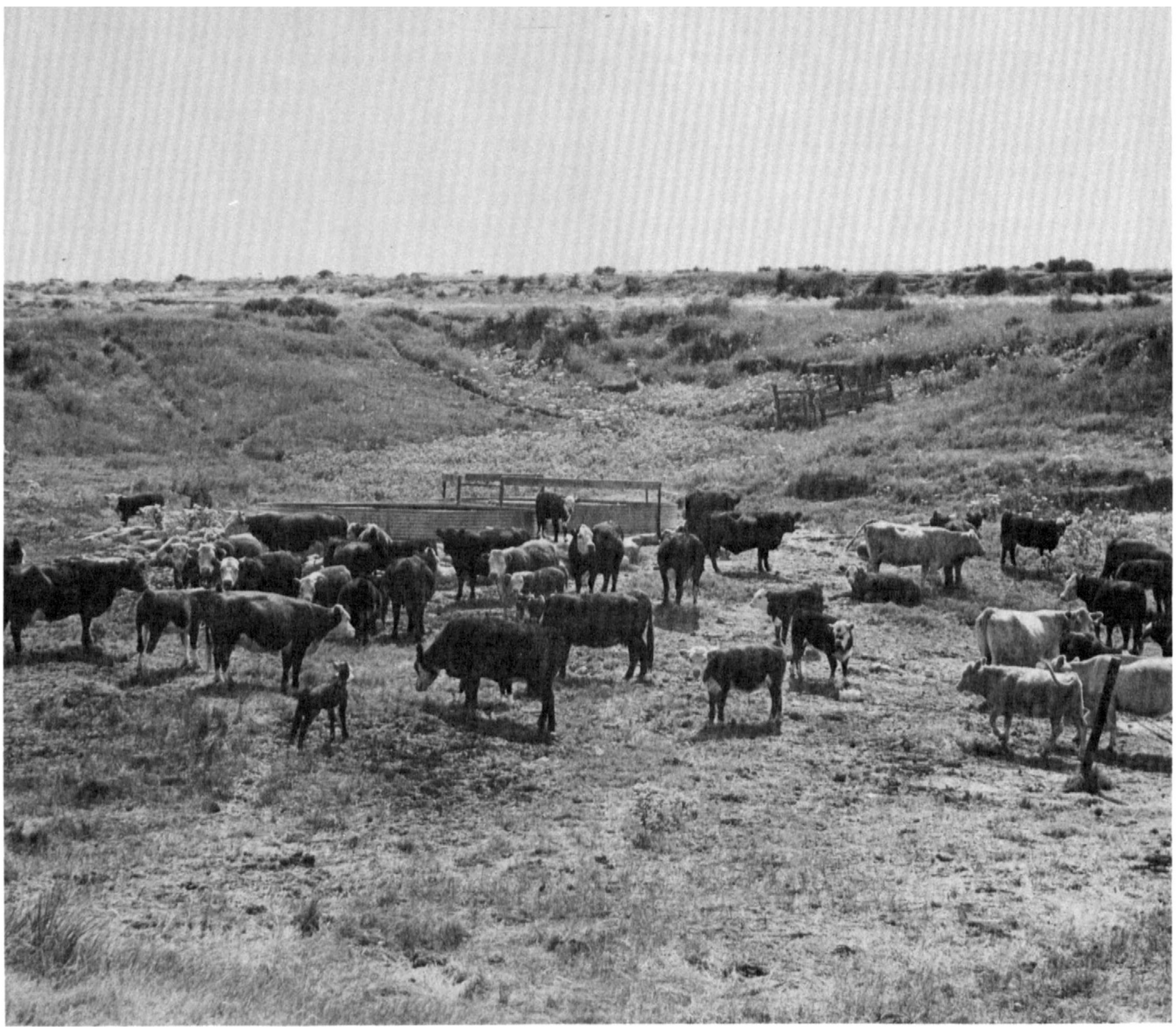
United States
Department of
Agriculture

Soil
Conservation
Service

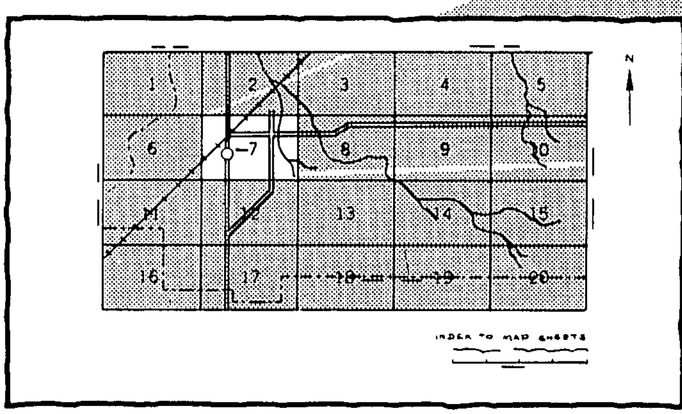
In cooperation with
Kansas Agricultural
Experiment Station

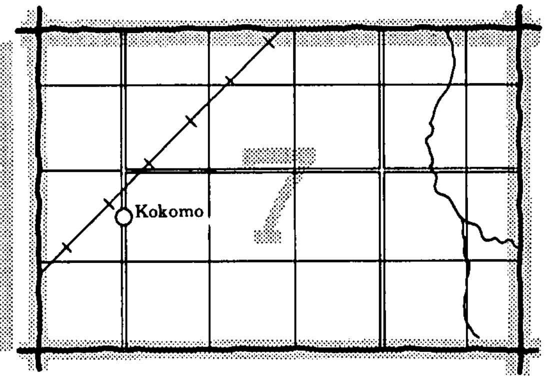
Soil Survey of Wallace County, Kansas



HOW TO USE

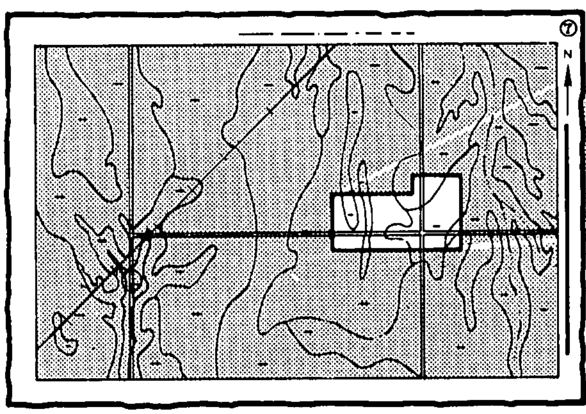
1. Locate your area of interest on the "Index to Map Sheets."

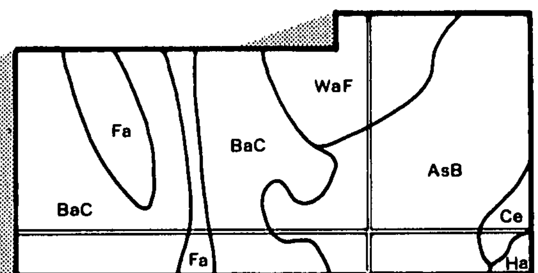




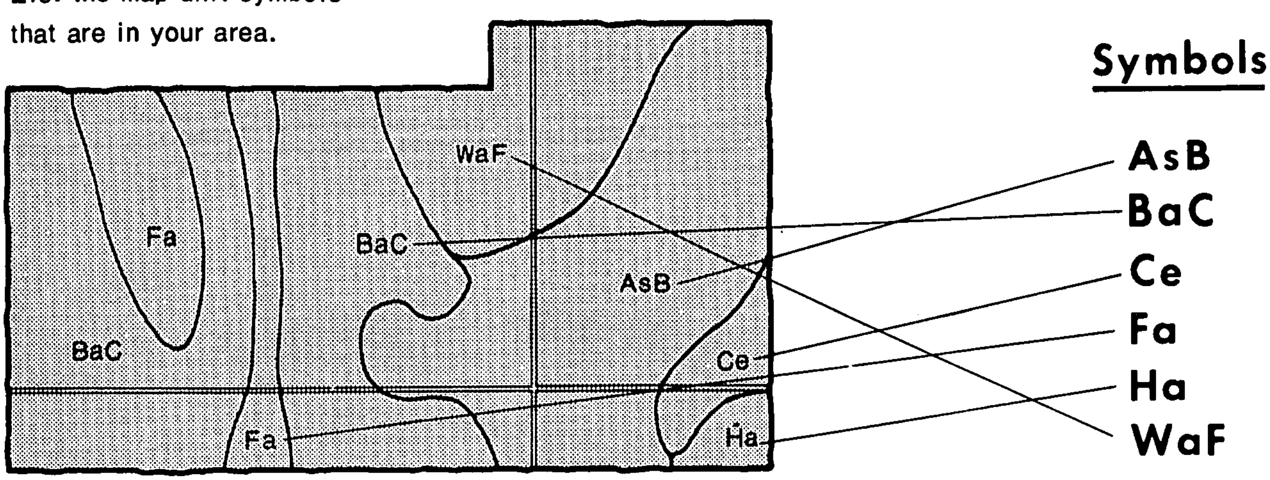
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



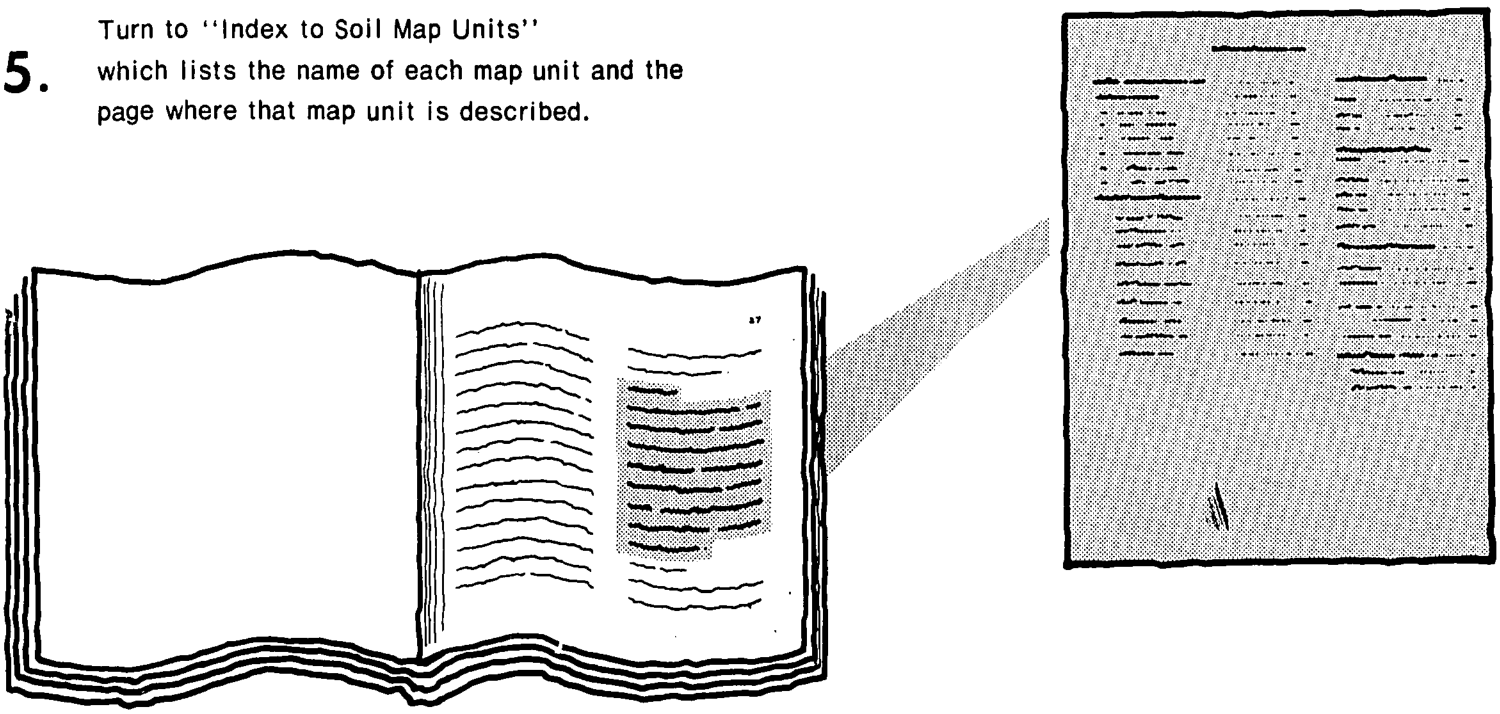


4. List the map unit symbols that are in your area.

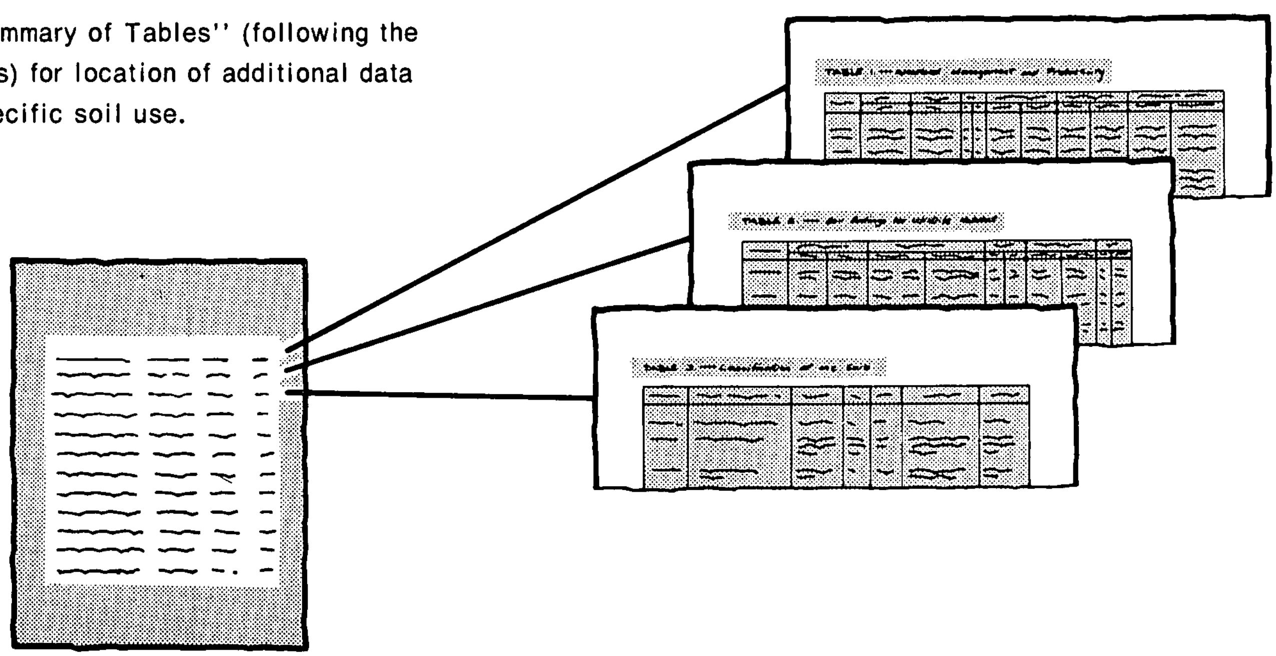


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1982-83. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Wallace County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: A spring watering facility in an area of Midway soils. This facility is part of a good range management program.

Contents

Soil Series

Issued March 1986

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Wallace County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie

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State Conservationist
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Soil Survey of Wallace County, Kansas

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United States Department of Agriculture, Soil Conservation Service
In cooperation with
the Kansas Agricultural Experiment Station

Wallace County is in the west-central part of Kansas (fig. 1). It has a total area of 584,698 acres, or 913 square miles. The population in 1982 was 2,073. In that year, Sharon Springs, the county seat, had a population of 1,004. Other towns are Weskan and Wallace. The county was organized in 1888.

General Nature of the County

The county is in the Central High Tablelands major land resource area. Generally, the soils are deep, are nearly level to moderately sloping, and have a silty subsoil. Elevation ranges from 4,039 feet above sea level at Mt. Sunflower, the highest point in Kansas, in the northwestern part of the county, to about 3,140 feet in the channel of the South Smoky Hill River, in the eastern part. Most of the county is drained by the north and south forks of the Smoky Hill River, Ladder Creek, Sand Creek, Lake Creek, Goose Creek, Willow Creek, and Rose Creek (fig. 2). Other common landscape features are shallow, undrained depressions and intermittent drainageways. Also, several deep, steep-sided basins have resulted from abrupt sinking of the ground. A well known cave-in sink, referred to as Old Maids Pool, is northwest of Sharon Springs.

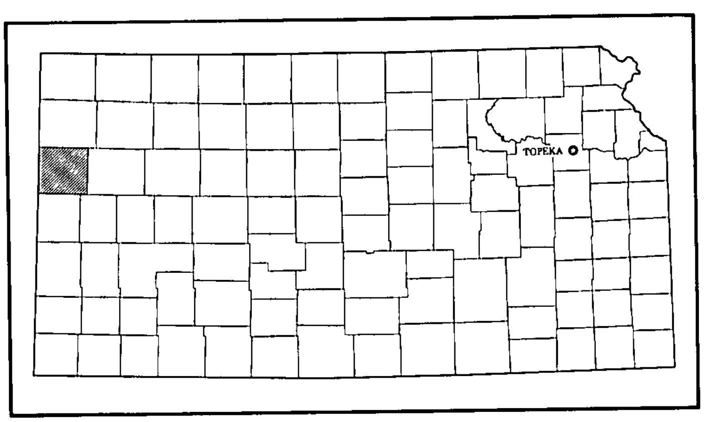

Figure 1.—Location of Wallace County in Kansas.

The main enterprises in the county are farming and ranching, but oil and gas wells have been developed. Winter wheat, sorghum, and corn are the principal crops. Most of the corn is irrigated.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Wallace County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. The climate is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air, but they last only from December through February. Warm summer temperatures last for about 6 months every year. Spring and fall are relatively short. Because the elevation of Wallace County is higher than that of counties to the east, the growing season also is relatively short.

The county lies within the rain shadow of the Rocky Mountains. Moisture-laden currents of air from the Gulf of Mexico generally move northward farther to the east, and the Pacific maritime air has precipitated its moisture in the mountains. Precipitation amounts are usually inadequate for crop production because of high rates of evaporation resulting from warm temperatures and relatively high wind velocities. Successful farming

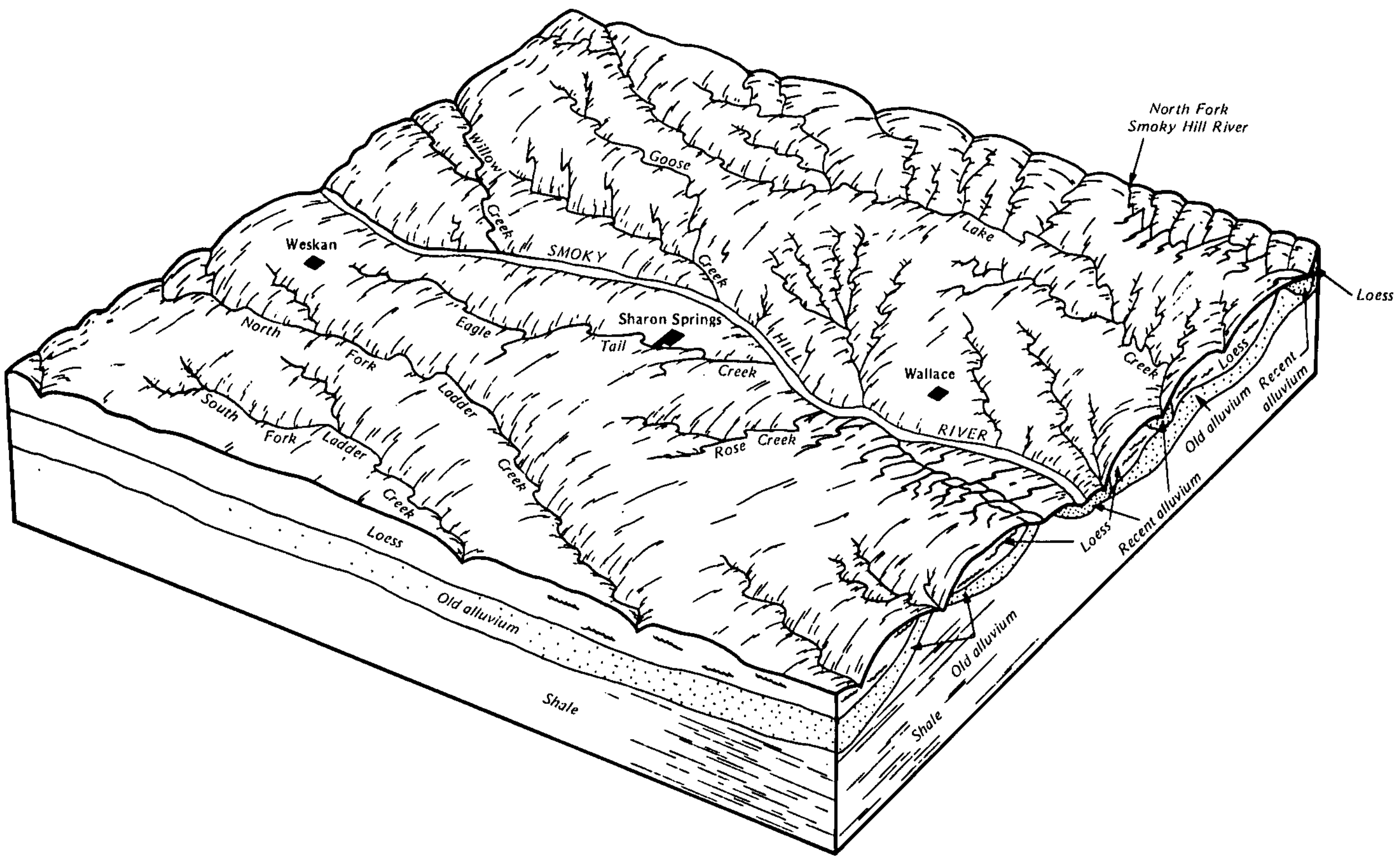

Figure 2.—Drainage, relief, and geologic material in Wallace County.

depends on irrigation, summer fallow, and extensive use of conservation practices. Dry conditions in the fall and winter sometimes limit the growth of wheat, so that fields do not have a good plant cover when the windy spring arrives. Under these conditions, the damage caused by soil blowing is heavy.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Sharon Springs in the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 33.8 degrees F, and the average daily minimum temperature is 18.5 degrees. The lowest temperature on record, which occurred at Sharon Springs on January 11, 1918, is -25 degrees. In summer the average temperature is 76.6 degrees, and the average daily maximum temperature is 92.6 degrees. The highest recorded temperature, which occurred at Sharon Springs on June 24, 1971, is 112 degrees.

The total annual precipitation is 17.95 inches. Of this, 13.71 inches, or 76 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 10.24 inches. The heaviest 1-day rainfall on record, which occurred at Sharon Springs on May 24, 1905, is 6.13 inches.

Hail falling during severe thunderstorms can result in considerable damage. The time of frequent hailstorms often coincides with the time when the wheat crop is in its most vulnerable stage, prior to harvest. Although these storms are local in extent, they occur frequently enough to be considered a major risk to crops in Wallace County.

The average seasonal snowfall is 28.5 inches. The highest seasonal snowfall during the period of record was 52 inches, which occurred during the winter of 1959-60. On the average, 32 days of the year have at least 1 inch of snow on the ground. The snow cover rarely lasts for more than 2 weeks.

The sun shines 77 percent of the time possible in summer and 68 percent in winter. The prevailing wind is

from the south. Average windspeed is highest, 14.6 miles per hour, in March. Average annual windspeed is 12.7 miles per hour.

Natural Resources

Soil is the most important natural resource in Wallace County. Most of the soils are fertile and well suited to agricultural uses. Other natural resources are water, sand, gravel, oil, gas, and volcanic ash. An adequate supply of sand and gravel is available for roads and other uses. The ash deposits are thin and have not been commercially developed.

Water is available in sufficient quantity and quality for irrigation in many areas. Most of the water is pumped from the Ogallala Formation. Lesser amounts are pumped from wells in alluvial and terrace deposits along the major streams. A small amount is surface water from streams. Saturated material in the Ogallala Formation is thickest in the west-central and southeastern parts of the county. The largest concentration of irrigation wells is in these areas.

Recharge of water in the Ogallala aquifer is minor, and the water level is declining in the areas where use is heavy. Recharge in the alluvial and terrace deposits is somewhat higher, but heavy pumping has reduced streamflow, particularly during periods of heavy use.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Soil Association Descriptions

1. Ulysses-Colby Association

Deep, nearly level to strongly sloping, well drained soils that have a silty subsoil; on uplands

This association is on ridgetops and side slopes dissected by upland drainageways. Slope ranges from 0 to 15 percent.

This association makes up about 55 percent of the county. It is about 70 percent Ulysses soils, 17 percent Colby soils, and 13 percent minor soils (fig. 3).

The nearly level to moderately sloping Ulysses soils formed in loess. Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The gently sloping to strongly sloping Colby soils formed in loess. Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The next layer is pale brown, friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are Bridgeport, Caruso, Goshen, Manter, and Pleasant soils. The calcareous Bridgeport soils are on stream terraces and flood plains. The somewhat poorly drained Caruso soils are on flood plains. Goshen soils are in upland swales. They have a thick, dark surface soil. The loamy Manter soils are on side slopes and knolls in the uplands. The moderately well drained Pleasant soils are in depressions in the uplands.

This association is used for cultivated crops and range. Most of the nearly level and gently sloping areas are cultivated. The steeper areas are used mainly as range. Wheat and sorghum are the main crops in nonirrigated areas. A few areas are irrigated. Corn, sorghum, alfalfa, and wheat are the main irrigated crops. Controlling erosion, maintaining tilth and fertility, and conserving moisture are the main management concerns in cultivated areas. Maintaining the growth and vigor of desirable grasses is the main concern in managing range.

2. Keith-Ulysses Association

Deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands

This association is on broad ridgetops and on side slopes that have poorly defined drainage patterns because of undrained depressions and small basins. Slope ranges from 0 to 6 percent.

This association makes up about 25 percent of the county. It is about 45 percent Keith soils, 42 percent Ulysses soils, and 13 percent minor soils.

The nearly level Keith soils formed in loess. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown and grayish brown, friable silty clay loam, and the lower part is light brownish gray, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is light gray, calcareous silt loam.

The nearly level to moderately sloping Ulysses soils formed in loess. Typically, the surface layer is grayish

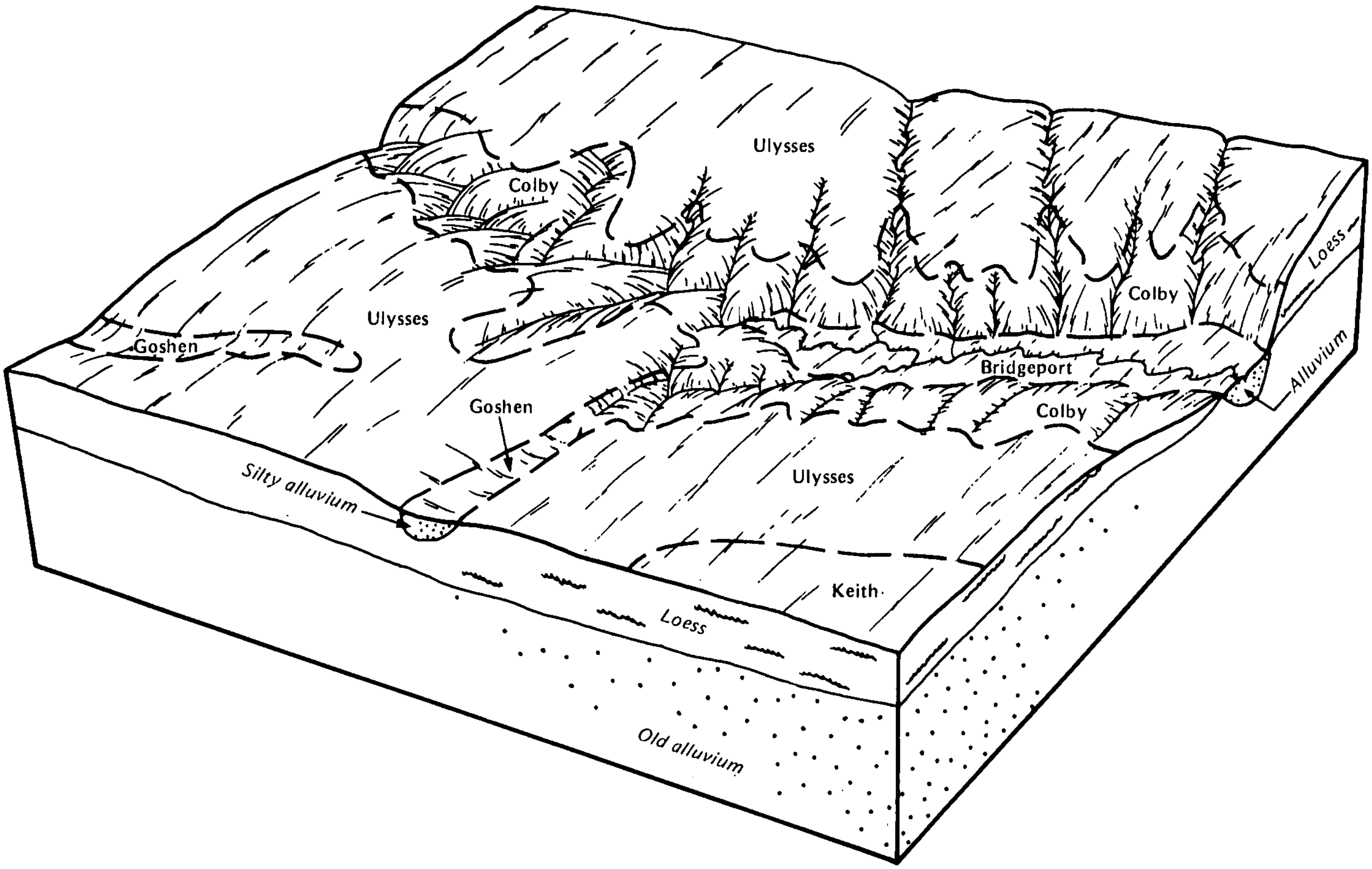

Figure 3.—Typical pattern of soils and underlying material in the Ulysses-Colby association.

brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are Colby, Goshen, and Pleasant soils. The calcareous Colby soils are on the steeper side slopes along drainageways. Goshen soils are in upland swales. They have a thick, dark surface soil. The moderately well drained Pleasant soils are in upland depressions.

This association is used mainly for cultivated crops. Winter wheat and grain sorghum are the main nonirrigated crops. Corn, sorghum, and wheat are the main irrigated crops. Measures that help to control erosion, conserve moisture, and maintain fertility are the major concerns of management.

3. Colby-Kim-Midway Association

Deep and shallow, moderately sloping to moderately steep, well drained soils that have a silty, loamy, or clayey subsoil; on uplands

This association is on narrow ridgetops and side slopes that are dissected by entrenched drainageways. Slope ranges from 3 to 20 percent.

This association makes up about 15 percent of the county. It is about 30 percent Colby soils, 20 percent Kim soils, 13 percent Midway soils, and 37 percent minor soils (fig. 4).

The deep Colby soils formed in loess. They are moderately sloping and strongly sloping. Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The next layer is pale brown, friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The deep Kim soils formed in old alluvium. They are moderately sloping to moderately steep. Typically, the surface layer is grayish brown, calcareous loam about 6 inches thick. The next layer is pale brown, friable, calcareous clay loam about 12 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam.

The shallow Midway soils formed in material weathered from calcareous shale. They are moderately sloping to moderately steep. Typically, the surface layer is grayish brown, calcareous clay about 4 inches thick. The substratum is grayish brown, calcareous clay. Shale bedrock is at a depth of about 12 inches.

The minor soils in this association are Bridgeport, Canyon, Otero, Razor, and Ulysses soils. The silty Bridgeport soils are on stream terraces and flood plains. The shallow Canyon soils are on the steeper side slopes. The loamy Otero soils are on the lower side slopes. The moderately deep Razor soils are on ridges adjacent to the Midway soils. The deep, silty Ulysses soils are on ridgetops.

This association is used mainly as range. Maintaining the growth and vigor of the desirable native grasses is the main management concern.

4. Bridgeport-Bankard Association

Deep, nearly level to moderately sloping, well drained and somewhat excessively drained soils that have a silty or sandy subsoil; on stream terraces, flood plains, and alluvial fans

This association is on broad stream terraces and flood plains dissected by river and stream channels. Slope ranges from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 50 percent Bridgeport soils, 35 percent Bankard soils, and 15 percent minor soils.

The well drained Bridgeport soils formed in silty alluvium. They generally are nearly level. In a few areas,

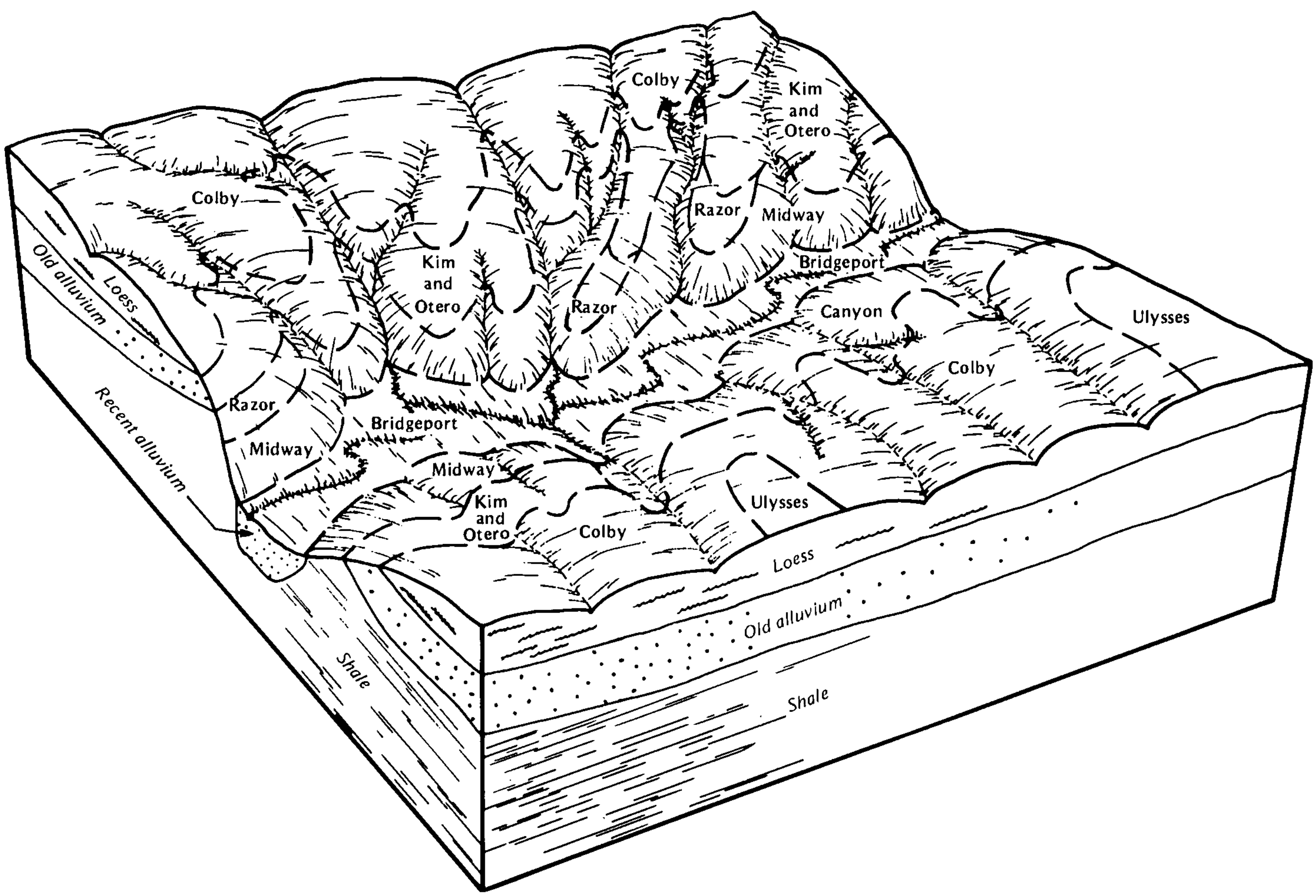

Figure 4.—Typical pattern of soils and underlying material in the Colby-Kim-Midway association.

however, they are moderately sloping. Typically, the surface layer is grayish brown, calcareous silt loam about 12 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam.

The somewhat excessively drained Bankard soils formed in sandy and loamy alluvium. They are nearly level. Typically, the surface layer is grayish brown, calcareous sandy loam about 5 inches thick. The next layer is pale brown, calcareous loamy sand about 7 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous sand.

The minor soils in this association are Arvada, Caruso, Glenberg, and Sweetwater soils. The sodic Arvada soils are on rarely flooded stream terraces. The somewhat poorly drained Caruso and poorly drained Sweetwater soils are on low flood plains. The loamy Glenberg soils are on stream terraces.

The loamy Bankard soils are used mainly as range, and the silty Bridgeport soils are used mainly for cultivated crops. The principal crops are wheat, grain sorghum, forage sorghum, corn, and alfalfa. Some areas are irrigated by sprinklers. Flooding is a hazard in some years. Maintaining good tilth and fertility is the major concern in managing cropland. Maintaining a vigorous stand of native grasses is the main concern in managing range.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Ulysses silt loam, 1 to 3 percent slopes, is one of several phases in the Ulysses series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Kim-Otero complex, 5 to 20 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

Bb—Bankard loamy sand, occasionally flooded. This deep, nearly level, somewhat excessively drained soil is on flood plains. It occurs mainly as one long, continuous area along the Smoky Hill River.

Typically, the surface layer is grayish brown, calcareous loamy sand about 5 inches thick. The substratum to a depth of about 60 inches is very pale brown sand. In some areas the surface layer is loam or gravelly sand. The areas where the surface layer is gravelly sand are adjacent to the river or stream channels.

Included with this soil in mapping are small areas of barren gravelly sand on low flood plains along the river or stream channels. These areas make up about 10 percent of the map unit.

Permeability is rapid in the Bankard soil. Available water capacity is very low. Surface runoff is slow. Organic matter content and natural fertility are low. The surface layer is moderately alkaline.

Nearly all of the acreage is range. Because of the flooding and the very low available water capacity, this soil is generally unsuited to cultivation. It is suited to range. The native vegetation dominantly is sand bluestem, prairie sandreed, needleandthread, western wheatgrass, and sand sagebrush. Overgrazed areas are dominated by blue grama, sand dropseed, and annual weeds. Soil blowing is a hazard if the plant cover is removed. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive.

This soil is generally unsuited to building site development because of the flooding. It is a probable source of sand.

The land capability classification is VIw, nonirrigated. The range site is Sands.

Bc—Bankard sandy loam. This deep, nearly level, somewhat excessively drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous sandy loam about 5 inches thick. The next layer is pale brown, calcareous loamy sand about 7 inches thick. The substratum to a depth of about 60 inches is very pale brown sand. In some areas the surface layer is loam or loamy sand.

Included with this soil in mapping are a few small areas of Glenberg soils. These soils have a loamy subsoil. They are on the slightly higher stream terraces. They make up about 5 percent of the map unit.

Permeability is rapid in the Bankard soil. Available water capacity is low. Surface runoff is slow. Organic matter content and natural fertility are low. The surface layer is moderately alkaline.

Most areas are used as range. This soil is generally unsuited to nonirrigated crops and is poorly suited to irrigated crops. The low available water capacity is the main limitation. Also, soil blowing is a hazard. A few areas are irrigated by sprinklers. Wheat, grain sorghum, forage sorghum, and alfalfa are the principal irrigated crops. Measures that conserve moisture and help to control soil blowing are the main management needs. Stripcropping and conservation tillage systems that leave a protective cover of crop residue on the surface help to prevent excessive soil blowing. Soil moisture can be stored or conserved by crop residue management; stripcropping, which helps to trap snow; and efficient use of irrigation water.

This soil is suited to range. The native vegetation dominantly is prairie sandreed, sand bluestem, needleandthread, and some sand sagebrush. Overgrazed areas are dominated by blue grama, sand dropseed, and sand sagebrush. Soil blowing is a hazard unless a protective plant cover is maintained. Reseeding may be necessary in areas where the more desirable grasses have been removed. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and other structures lessen this hazard. Onsite inspection and knowledge of the history of flooding in a given area are needed when building sites are selected.

This soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. The soil is generally unsuited to sewage lagoons because of seepage. It is a probable source of sand.

The land capability classification is VIs, nonirrigated, and IVs, irrigated. The range site is Sandy.

Bo—Bridgeport loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along small creeks and intermittent drainageways. Individual areas are narrow and elongated. They are 200 to 300 feet wide, 600 feet to more than a mile long, and 10 to 100 acres in size.

Typically, the surface layer is grayish brown loam about 8 inches thick. The subsurface layer is dark grayish brown, calcareous loam about 8 inches thick. The subsoil is grayish brown, calcareous loam about 14 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. It is grayish brown in the upper part and light brownish gray in the lower part. In some areas the surface layer is clay loam.

Included with this soil in mapping are small areas of Bankard and Caruso soils. The sandy Bankard soils are on the slightly higher stream terraces. The somewhat poorly drained Caruso soils are near stream channels. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Bridgeport soil, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is mildly alkaline.

Most areas are used as range. A few are used for cultivated crops. This soil is moderately well suited to wheat and grain sorghum. Yields are reduced in some years because of the flooding, but in other years they are increased by the extra moisture. Operating machinery is difficult in some areas along the meandering stream channels. Conservation tillage systems leave a protective cover of crop residue on the surface, help to maintain good tilth, and increase the rate of water infiltration.

This soil is suited to range. The native vegetation is big bluestem, sideoats grama, and western wheatgrass. Overused areas are dominated by less productive grasses, such as blue grama, buffalograss, and inland saltgrass. Recurrent flooding, channeling, and deposition are hazards. Areas near watering facilities and shade trees where animals congregate are overgrazed. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Locating salt blocks on the steeper adjacent soils helps to distribute grazing more evenly.

This soil is generally unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIIw, nonirrigated, and IIw, irrigated. The range site is Loamy Lowland.

Bp—Bridgeport silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on low terraces and alluvial fans near the larger streams. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface soil is grayish brown, calcareous silt loam about 12 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam. In some areas the surface layer is sandy loam or is noncalcareous.

Included with this soil in mapping are small areas of Arvada and Glenberg soils. Arvada soils are alkali. They are in microdepressions. The loamy Glenberg soils are on mounds. Included soils make up about 5 percent of the map unit.

Permeability is moderate in the Bridgeport soil, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is moderately alkaline. Tilth is good.

About 70 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. Alfalfa is grown in a few areas. Inadequate rainfall is the main concern in managing the areas used for nonirrigated crops. Measures that conserve moisture and help to control soil blowing are the main management needs. Stripcropping and conservation tillage systems that leave a protective cover of crop residue on the surface help to prevent excessive soil blowing. Soil moisture can be stored or conserved by crop residue management; stripcropping, which helps to trap snow; and summer fallowing. Soil blowing on fallowed land can be controlled by stubble mulching or by controlling the vegetation through applications of chemicals.

Many areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. The main management needs are measures that maintain fertility, tilth, and the organic matter content and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the organic matter content, tilth, and fertility. Land leveling and water management improve water distribution.

This soil is suited to range. In many areas, the range is overgrazed and the more desirable grasses have been replaced by less productive grasses and by weeds. Big bluestem, sideoats grama, and western wheatgrass are the more desirable grasses. The overgrazed areas are dominated by blue grama, buffalograss, and inland saltgrass. Water erosion is a hazard unless a protective plant cover is maintained. Cattle tend to congregate around watering facilities. Locating salt blocks on the steeper adjacent soils helps to distribute grazing more evenly. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, or other flood-control structures are needed. The higher parts of the landscape should be selected as building sites.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields, but it can be controlled by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the floor of the lagoon.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Loamy Terrace.

Br—Bridgeport silt loam, 2 to 6 percent slopes. This deep, moderately sloping, well drained soil is on stream terraces and alluvial fans. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The next layer is grayish brown, friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam.

Included with this soil in mapping are small areas of Colby and Ulysses soils. Ulysses soils have a noncalcareous surface layer, and Colby soils have a strongly calcareous surface layer. Both soils are on uplands. They make up about 10 percent of the map unit.

Permeability is moderate in the Bridgeport soil, and surface runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is mildly alkaline. Tilth is good.

About 50 percent of the acreage is cultivated. The rest is used as range. This soil is moderately well suited to nonirrigated and irrigated crops. Wheat and sorghum are the main nonirrigated crops. If cultivated crops are grown, erosion is a hazard. Conserving moisture is an additional concern. Minimum tillage, terraces, contour farming, and stubble mulching conserve moisture and help to prevent excessive soil loss. In some areas diversions are needed to protect the soil from runoff from the adjacent uplands.

Some areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. Erosion is the main hazard. Conservation tillage systems that leave crop residue on the surface help to prevent excessive soil loss. If a gravity irrigation system is used, land leveling generally is needed before the irrigation water can be managed efficiently. Controlling the rate of water application conserves irrigation water and helps to prevent excessive soil loss.

This soil is suited to range. The native vegetation dominantly is big bluestem, sideoats grama, and western wheatgrass. Overgrazed areas are dominated by less

productive grasses, such as blue grama, buffalograss, and inland saltgrass. Water erosion is a hazard unless a protective plant cover is maintained. A scheduled deferment of grazing during the growing season helps to maintain the stand of desirable grasses. Winter and spring grazing helps to control weedy vegetation.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because slope and seepage are limitations. Sealing the floor of the lagoon helps to control seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, nonirrigated and irrigated. The range site is Loamy Terrace.

Bs—Bridgeport-Arvada complex. These deep, nearly level, well drained soils are on stream terraces. They are subject to rare flooding. The Arvada soil is in the flatter concave areas, and the Bridgeport soil is in the slightly higher areas. Individual areas are irregular in shape and range from 10 to 80 acres in size. They are about 55 percent Bridgeport soil and 40 percent Arvada soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Bridgeport soil has a grayish brown silt loam surface layer about 6 inches thick. The subsoil is brown, calcareous silty clay loam about 6 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous silty clay loam.

Typically, the Arvada soil has a light brownish gray loam surface layer about 2 inches thick. The subsoil is firm, calcareous silty clay loam about 41 inches thick. The upper part is grayish brown, and the lower part is pale brown. The substratum to a depth of about 60 inches is very pale brown, calcareous silty clay loam.

Included with these soils in mapping are small areas of the clayey Limon soils on stream terraces near the uplands. These included soils make up about 5 percent of the map unit.

Permeability is moderate in the Bridgeport soil and very slow in the Arvada soil. The Arvada soil does not absorb moisture easily or release it readily to plants. Available water capacity is high in the Bridgeport soil and low in the Arvada soil. Surface runoff is slow on both soils. Natural fertility is low in the Arvada soil and medium in the Bridgeport soil. The content of sodium and soluble salts in the subsoil of the Arvada soil adversely affects the growth of most plants. Organic matter content is moderately low in both soils.

Only a small acreage is used for cultivated crops. The rest is used as range. These soils are generally unsuited to nonirrigated crops and are poorly suited to irrigated crops. Most cultivated areas are irrigated. Corn, sorghum, and alfalfa are the principal irrigated crops. The main management needs are measures that maintain fertility, tilth, and the organic matter content and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the organic matter content, tilth, and fertility. Land leveling and water management improve water distribution and the efficiency of irrigation.

These soils are suited to range. The native grasses are dominantly sideoats grama, western wheatgrass, and big bluestem, which are the more desirable grasses. In a few areas, the range is overgrazed and the more desirable grasses have been replaced by less productive grasses and by weeds. Water erosion is a hazard unless a protective plant cover is maintained. Salinity and alkalinity reduce production on the Arvada soil. A proper stocking rate, a uniform grazing distribution, and a scheduled deferment of grazing during the growing season help to keep the range productive.

These soils are generally unsuited to building site development because of the flooding.

The land capability classification is VIs, nonirrigated, and IVs, irrigated. The Bridgeport soil is in the Loamy Terrace range site, and the Arvada soil is in the Saline Lowland range site.

Cd—Canyon loam, 5 to 30 percent slopes. This shallow, moderately sloping to steep, somewhat excessively drained soil is on side slopes along deeply dissected drainageways. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 4 inches thick. The next layer is light brownish gray, calcareous gravelly loam about 4 inches thick. The substratum is very pale brown, calcareous gravelly loam. Very pale brown, weakly cemented caliche bedrock is at a depth of about 14 inches.

Included with this soil in mapping are small areas of Colby, Kim, and Otero soils and rock outcrops. The deep, silty Colby soils are on the upper side slopes. The deep Otero and Kim soils are on the lower side slopes. The rock outcrops are caliche or limy sandstone on the steeper side slopes. Included areas make up about 15 percent of the map unit.

Permeability is moderate in the Canyon soil. Surface runoff is rapid. Available water capacity is very low. Root development is restricted below a depth of about 14 inches. Organic matter content and natural fertility are low. The surface layer is mildly alkaline or moderately alkaline.

Nearly all areas are used as range. Because of the slope and the rock outcrops, this map unit is generally unsuited to cultivated crops. It is suited to range. The native grasses are dominantly little bluestem and sideoats grama. Water erosion is a hazard unless a protective plant cover is maintained. The steeper slopes commonly are less intensively grazed than the flatter slopes. Well distributed watering and salting facilities and

properly located fences improve the distribution of grazing. A proper stocking rate and a scheduled deferment of grazing during the growing season help to keep the range productive.

This soil is generally unsuited to building site development because of the slope and the shallow depth to bedrock.

The land capability classification is VIs, nonirrigated. The range site is Shallow Limy.

Ch—Caruso loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains along some of the larger streams. Areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 6 inches thick. The subsurface layer is dark grayish brown, friable, calcareous loam about 10 inches thick. The substratum to a depth of about 60 inches is mottled, calcareous loam. The upper part is light brownish gray, the next part is light gray, and the lower part is light brownish gray. In some areas the surface layer is light brownish gray. In other areas the substratum is not mottled.

Included with this soil in mapping are small areas of the well drained Bridgeport soils on the slightly higher stream terraces and the poorly drained Sweetwater soils on flood plains. Also included are small areas of saline soils. Included soils make up about 5 percent of the map unit.

Permeability is moderate in the Caruso soil, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is moderately alkaline. A seasonal high water table is at a depth of 2 to 3 feet in the spring. Tilth is good.

Most areas are used as range. This soil is well suited to range. Grazing when the soil is too wet causes surface compaction. The dominant native grasses are big bluestem, switchgrass, and prairie cordgrass. If these grasses are overgrazed, the amount of western wheatgrass and annual grasses and forbs increases. Controlled grazing improves the growth and vigor of the more palatable and productive, taller grasses. Water erosion is a hazard unless a protective plant cover is maintained. A proper stocking rate, a scheduled deferment of grazing during the growing season, and well distributed salting and watering facilities improve the range condition. Areas managed as hay meadows produce excellent cuttings of native hay (fig. 5).

This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. It is poorly suited to wheat because it is subject to flooding. Sorghum and alfalfa are the main nonirrigated crops. The flooding is the main hazard, and the seasonal high water table is the main limitation. Measures that help to control flooding are the main management needs. In some areas diversion terraces are needed to control runoff from the adjacent uplands.

Some areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. Measures that help to control flooding, improve fertility and tilth, increase the organic matter content, and result in the efficient use of irrigation water are needed.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is IIIw, nonirrigated, and IIw, irrigated. The range site is Subirrigated.

Co—Colby silt loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil is on upland side slopes and along upland drainageways. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The next layer is pale brown, friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas erosion has exposed the very pale brown substratum. In other areas the surface layer is dark grayish brown.

Included with this soil in mapping are small areas of Kim, Otero, and Ulysses soils, which make up about 15 percent of the map unit. Ulysses soils have a noncalcareous surface layer that is darker than that of the Colby soil. Their positions on the landscape are similar to those of the Colby soil. The loamy Kim and Otero soils are on the steeper slopes below the Ulysses soils.

Permeability is moderate in the Colby soil, and surface runoff is medium. Available water capacity is high. Natural fertility is medium, and organic matter content is low. The surface layer is moderately alkaline.

About 60 percent of the acreage is used as range. The rest is used as cropland. This soil is poorly suited to nonirrigated and irrigated crops. Wheat and grain sorghum are the main nonirrigated crops. Sorghum is susceptible to chlorosis because of a high content of lime in the soil. Measures that help to control erosion and conserve moisture are the main management needs. Examples are summer fallowing, terracing, contour farming, and stubble mulching.

Some areas are irrigated, mainly by sprinklers. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The major management needs are measures that help to control erosion and maintain fertility. Terraces and contour farming help to prevent excessive soil loss and runoff.

This soil is suited to range. The native vegetation dominantly is little bluestem, sideoats grama, western wheatgrass, and blue grama. Overgrazed areas are dominated by blue grama, buffalograss, tall dropseed, and small soapweed. Water erosion is a hazard unless a

Figure 5.—An area of Caruso loam, occasionally flooded, used for native hay.

protective plant cover is maintained. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because seepage and slope are limitations. Some land shaping is commonly needed. Sealing the floor of the lagoon helps to control seepage.

The land capability classification is IVe, nonirrigated and irrigated. The range site is Limy Upland.

Cp—Colby silt loam, 6 to 15 percent slopes. This deep, strongly sloping, well drained soil is on side slopes along upland drainageways. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The next layer is pale brown, friable, calcareous silt loam about 4 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas erosion has exposed the very pale brown substratum. In other areas the surface layer is dark grayish brown.

Included with this soil in mapping are small areas of Canyon, Kim, and Bridgeport soils, which make up about 15 percent of the map unit. The shallow Canyon soils and the loamy Kim soils are on the lower side slopes. Bridgeport soils are on bottom land and are occasionally flooded.

Permeability is moderate in the Colby soil, and surface runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is low. The surface layer is moderately alkaline.

Nearly all of the acreage is used as range. Because of a severe erosion hazard, this soil generally is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is little bluestem, sideoats grama, western wheatgrass, and blue grama. Overgrazed areas are dominated by blue grama, buffalograss, tall

dropseed, and small soapweed. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is moderately well suited to dwellings. Because of the slope, some land shaping commonly is needed. The south-facing slopes are ideal sites for dwellings that are partly underground.

Because of the slope, this soil generally is unsuitable as a site for sewage lagoons and is only moderately well suited to septic tank absorption fields. The lateral lines in absorption fields should be installed on the contour.

The land capability classification is VIe, nonirrigated. The range site is Limy Upland.

Ec—Elkader silt loam, 2 to 6 percent slopes. This deep, moderately sloping, well drained soil is on upland side slopes. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 10 inches thick. The subsoil is pale brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown and light yellowish brown, calcareous silt loam. In some areas the surface layer is loam. In a few small eroded areas, it is pale brown.

Included with this soil in mapping are small areas of Ulysses soils on the upper side slopes. These soils have a noncalcareous surface layer. They make up about 10 percent of the map unit.

Permeability is moderate in the Elkader soil, and surface runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderately low. The surface layer is moderately alkaline. Tilth is good.

About 40 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is poorly suited to nonirrigated crops and is moderately well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. Sorghum is susceptible to chlorosis because of a high content of lime in the soil. Erosion and drought are the main hazards. Summer fallowing, terracing, farming on the contour, and stubble mulching conserve moisture and help to prevent excessive soil loss.

Some areas are irrigated, mainly by sprinkler systems. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The main management needs are measures that help to control erosion and maintain fertility and the efficient use of irrigation water. Minimizing tillage, applying fertilizer, and keeping crop residue on the surface help to maintain the organic matter content and improve tilth and fertility. Terraces and contour farming help to prevent excessive soil loss. Excessive loss of irrigation water through runoff can be prevented by applying the water at the proper rate.

This soil is suited to range. The native grasses dominantly are big bluestem, little bluestem, sideoats grama, and blue grama. Overgrazed areas are dominated by less productive grasses, such as buffalograss. Water erosion is a hazard unless a protective plant cover is maintained. A proper stocking rate and a scheduled deferment of grazing during the growing season help to keep the range productive. Range seeding is needed to restore productivity on abandoned cropland.

The many areas where range is adjacent to cropland can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these fringe areas provides winter cover for the wildlife.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because of seepage and slope. Sealing the floor of the lagoon helps to control seepage. Some land shaping is commonly needed to compensate for the slope.

The land capability classification is IVe, nonirrigated, and IIIe, irrigated. The range site is Limy Upland.

Gb—Glenberg sandy loam. This deep, nearly level, well drained soil is on stream terraces along the Smoky Hill River and the other major streams in the county. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 60 acres in size.

Typically, the surface layer is grayish brown, calcareous sandy loam about 5 inches thick. The next layer is brown, friable, calcareous sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is calcareous. The upper part is pale brown sandy loam, the next part is dark grayish brown loam, and the lower part is brown sandy loam.

Included with this soil in mapping are small areas of Bankard and Bridgeport soils. The somewhat excessively drained Bankard soils are in the slightly lower areas. The silty Bridgeport soils also are in the slightly lower areas. Included soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Glenberg soil, and available water capacity is moderate. Runoff is slow. Natural fertility is medium, and organic matter content is low. The surface layer is moderately alkaline. Tilth is good.

About half of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Soil blowing and drought are hazards if nonirrigated crops are grown. Minimum tillage and stubble mulching conserve moisture and help to control soil blowing. Crop yields are reduced in some years because of overflow, but in other years they can be increased by the extra moisture.

Corn, sorghum, and alfalfa are the main irrigated crops. Sprinklers are used in most irrigated areas. Maintaining fertility, efficiently using irrigation water, and preventing flood damage are concerns of management. Returning crop residue to the soil helps to maintain fertility. Good water management can improve water distribution and conserve water.

This soil is suited to range. Many areas are overgrazed because they are near watering sites and shade trees where livestock congregate. In these areas the grass is dominantly sand dropseed and blue grama. In areas where the range is in good condition, the principal grasses are little bluestem and switchgrass. Well distributed salting and watering facilities help to distribute grazing more evenly.

This soil is poorly suited to building site development because of the hazard of flooding. This hazard can be reduced by dikes, levees, and other flood-control diversions. The higher parts of the landscape should be selected as building sites.

This soil is moderately well suited to septic tank absorption fields and poorly suited to sewage lagoons. The flooding is a hazard. It can be controlled by levees. Seepage is an additional limitation on sites for sewage lagoons. It can be controlled by sealing the floor of the lagoon.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Sandy Terrace.

Go—Goshen silt loam. This deep, nearly level, well drained soil is in swales on uplands. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 8 inches thick (fig. 6). The subsurface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 32 inches thick. The upper part is dark grayish brown, firm silty clay loam; the next part is grayish brown, firm silty clay loam; and the lower part is light brownish gray, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In a few areas the surface layer is calcareous.

Permeability is moderate, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is neutral. Tilth is good.

About 60 percent of the acreage is cultivated. The rest is used as range. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Sorghum and wheat are the main nonirrigated crops. Alfalfa is grown in a few areas. Inadequate rainfall is the main concern in managing the areas used for nonirrigated crops. Summer fallowing, minimum tillage, and stubble mulching conserve moisture.

Some areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. The main management needs are measures that maintain fertility, tilth, and the organic matter content and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the organic matter content, tilth, and fertility. Land leveling and water management improve water distribution.

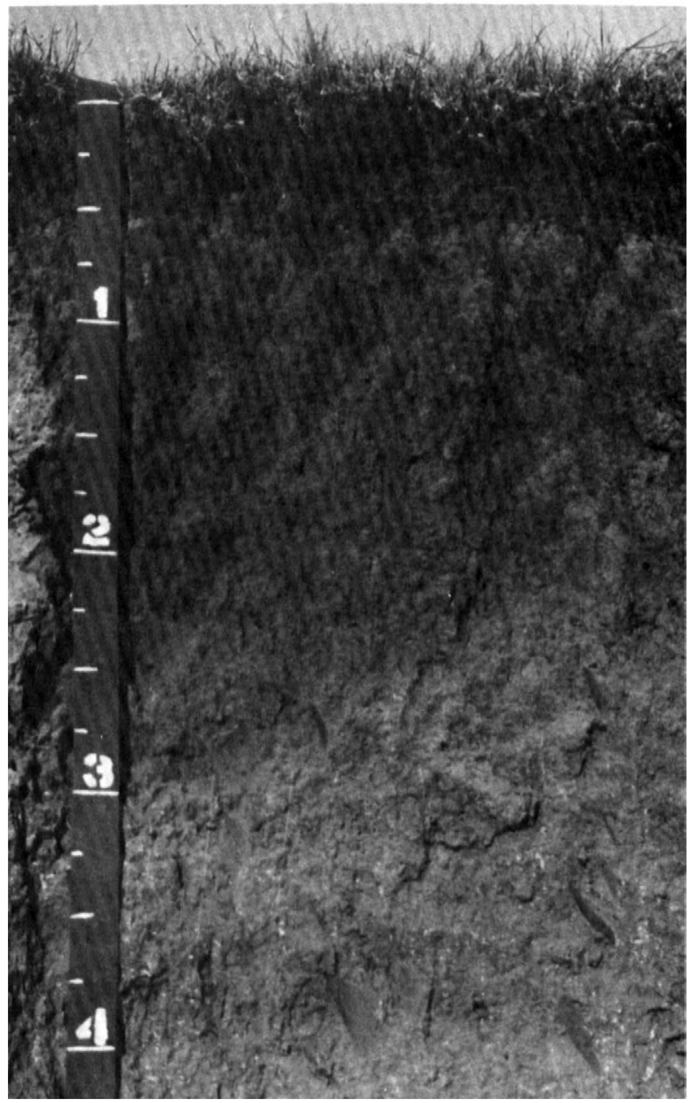

Figure 6.—Typical profile of Goshen silt loam. The surface soil and the upper part of the subsoil are dark. Depth is shown in feet.

This soil is suited to range. The native vegetation dominantly is big bluestem, sideoats grama, and little bluestem. In areas that are continually overgrazed, these productive grasses are replaced by less productive grasses, such as blue grama, western wheatgrass, and buffalograss. Erosion is a hazard if the range is overgrazed. Well distributed watering and salting facilities

improve the distribution of grazing. A proper stocking rate and a scheduled deferment of grazing during the growing season help to keep the range productive.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and other flood-control structures are needed. Onsite inspection and knowledge of the history of flooding in a given area are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. It can be controlled by levees. The moderate permeability restricts the absorption of effluent, but it can be overcome by enlarging the absorption field. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor of the lagoon.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Loamy Terrace.

Ke—Keith silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on upland flats, mainly on the divides between drainageways. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 4 inches thick. The subsoil is about 25 inches thick. The upper part is dark grayish brown and grayish brown, friable silty clay loam, and the lower part is light brownish gray, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In some areas the surface layer is calcareous or is silty clay loam, or both.

Included with this soil in mapping are small areas of the moderately well drained Pleasant soils in shallow depressions. These soils make up less than 5 percent of the map unit.

Permeability is moderate in the Keith soil, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is slightly acid. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. Measures that conserve moisture are the main management needs. Examples are summer fallowing, conservation tillage systems that leave crop residue on the surface, stubble mulching, and level terraces.

Corn and sorghum are the main irrigated crops. Alfalfa and wheat also are grown. The main management needs are measures that maintain fertility and the organic matter content and the efficient use of irrigation water. Land leveling and contour furrowing reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Leaving crop residue on the surface helps to maintain fertility and the organic matter content and reduces the runoff rate in areas irrigated by sprinklers. Tailwater pits help to recover irrigation water.

This soil is well suited to dwellings and septic tank absorption fields. The shrink-swell potential, however, is a limitation on sites for dwellings without basements. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. The soil is only moderately well suited to sewage lagoons because seepage is a limitation. Sealing the floor of the lagoon helps to control seepage.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Loamy Upland.

Ko—Kim-Otero complex, 5 to 20 percent slopes. These deep, moderately sloping to moderately steep, well drained soils are on side slopes along deeply dissected drainageways. The Kim soil is on the upper side slopes. The Otero soil generally is on the lower side slopes. Individual areas are irregular in shape and range from 10 to several hundred acres in size. They are about 60 percent Kim soil and 25 percent Otero soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Kim soil has a grayish brown, calcareous loam surface layer about 6 inches thick. The next layer is pale brown, friable, calcareous clay loam about 12 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam.

Typically, the Otero soil has a grayish brown, calcareous sandy loam surface layer about 5 inches thick. The next layer is light brownish gray, very friable, calcareous sandy loam about 7 inches thick. The substratum to a depth of about 60 inches is calcareous sandy loam. The upper part is pale brown, and the lower part is very pale brown. In some areas the substratum is gravelly sand below a depth of 40 inches. In other areas the surface layer is noncalcareous.

Included with these soils in mapping are small areas of Canyon, Colby, and Midway soils and gravelly outcrops. The shallow, loamy Canyon soils are near the steeper, upper side slopes. The silty Colby soils are on the upper side slopes. The shallow, clayey Midway soils are on the lower side slopes. The gravelly outcrops are on foot slopes. Included areas make up about 15 percent of the map unit.

Permeability is moderate in the Kim soil and moderately rapid in the Otero soil. Surface runoff is rapid on both soils. Available water capacity is high in the Kim soil and moderate in the Otero soil. Natural fertility is medium in both soils. Organic matter content is very low. The surface layer is moderately alkaline.

Nearly all areas are used as range. Because erosion is a severe hazard, these soils are generally unsuited to cultivated crops. They are suited to range. The native grasses are dominantly big bluestem and little bluestem

on the Kim soil and blue grama and sand dropseed on the Otero soil. In overgrazed areas the more desirable grasses are replaced by less productive vegetation, such as sand sagebrush, small soapweed, buffalograss, and blue grama. Water erosion is a hazard unless a protective plant cover is maintained. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing.

These soils are moderately well suited to dwellings and septic tank absorption fields. The slope is a limitation. Building sites can be improved by land shaping. Because of the slope, lateral lines in septic tank absorption fields should be installed on the contour. The moderate permeability of the Kim soil restricts the absorption of effluent in the absorption fields. It can be overcome, however, by enlarging the field. The soils are generally unsuited to sewage lagoons because of the slope.

The land capability classification is VIe, nonirrigated. The Kim soil is in the Limy Upland range site, and the Otero soil is in the Sandy range site.

Ku—Kuma silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on broad upland flats. Individual areas are irregular in shape and range from 80 to 1,000 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 43 inches thick. The upper part is dark grayish brown and brown, firm silty clay loam, and the lower part is dark grayish brown and pale brown, friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

Included with this soil in mapping are small areas of the moderately well drained Pleasant soils. These soils are in shallow depressions. They make up less than 1 percent of the map unit.

Permeability is moderate in the Kuma soil, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is neutral. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are cultivated. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. Measures that conserve moisture are the main management needs. Examples are summer fallowing, minimum tillage, and stubble mulching.

Many areas are irrigated. Corn and sorhgum are the main irrigated crops. Alfalfa and wheat also are grown. The main management needs are measures that maintain fertility, tilth, and the organic matter content and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface increase the organic matter content and improve tilth and fertility. Land leveling and water management improve water distribution.

This soil is well suited to dwellings and septic tank absorption fields. The shrink-swell potential, however, is a limitation on sites for dwellings without basements, and the moderate permeability is a limitation on sites for septic tank absorption fields. Properly designing and reinforcing foundations help to prevent the structural damage caused by shrinking and swelling. Enlarging the absorption field helps to overcome the moderate permeability. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor of the lagoon.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Loamy Upland.

Lm—Limon silty clay, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on slightly concave terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 20 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous silty clay about 4 inches thick. The next layer is very firm, calcareous silty clay about 29 inches thick. The upper part is grayish brown, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is calcareous silty clay loam. The upper part is light brownish gray, and the lower part is grayish brown. In places the surface layer is noncalcareous. In some areas near stream channels, the substratum has strata of gravelly sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Bridgeport and Razor soils. The silty Bridgeport soils are near stream channels. The moderately deep Razor soils are on upland side slopes. Included soils make up about 5 percent of the map unit.

Permeability is slow in the Limon soil. Surface runoff also is slow. Available water capacity is moderate. Organic matter content is low, and natural fertility is medium. The surface layer is moderately alkaline. Tilth is poor. The shrink-swell potential is high.

Nearly all areas are used as range. This soil is poorly suited to nonirrigated crops and is moderately well suited to irrigated crops. Because of the clayey texture, the soil releases moisture slowly to plants. It is suited to range. The native vegetation dominantly is western wheatgrass, green needlegrass, and fourwing saltbush. The major management concern is the moderate available water capacity. Overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Under these conditions, the more desirable grasses are replaced by less productive grasses and by weeds. A planned grazing system that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil is poorly suited to dwellings because of the flooding and the shrink-swell potential. Dikes, levees, and other flood-control structures are needed. The

higher parts of the landscape should be selected as building sites. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. The soil is well suited to sewage lagoons. It is generally unsuited to septic tank absorption fields because of the slow permeability.

The land capability classification is IVs, nonirrigated, and IIIs, irrigated. The range site is Clay Terrace.

Mc—Manter fine sandy loam, 2 to 5 percent slopes. This deep, moderately sloping, well drained soil is on upland mounds and side slopes. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The subsurface layer also is grayish brown fine sandy loam about 8 inches thick. The subsoil is very friable sandy loam about 20 inches thick. The upper part is brown, and the lower part is pale brown and calcareous. The substratum to a depth of about 60 inches is pale brown, calcareous sandy loam. In some areas the surface layer is calcareous. In other areas the substratum is silt loam.

Included with this soil in mapping are small areas of the Otero and Satanta soils. The calcareous Otero soils are on mounds. Satanta soils are on side slopes. They are more clayey than the Manter soil. Included soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Manter soil, and surface runoff is medium. Available water capacity is moderate. Organic matter content is moderate, and natural fertility is medium. The surface layer is neutral. Tilth is good.

About half of the acreage is used for cultivated crops. This soil is poorly suited to nonirrigated crops and is moderately well suited to irrigated corn, alfalfa, hay, and pasture grasses. Some areas are irrigated by sprinklers. Grain sorghum is the main nonirrigated crop, but wheat also can be grown if the crop residue is properly managed. Soil blowing is a severe hazard unless the surface is protected by crop residue or a plant cover. Water erosion is a hazard on the steeper side slopes. Measures that conserve moisture are needed. Wind stripcropping and stubble mulching are effective in controlling erosion. Terraces are needed in some areas to control runoff and conserve moisture.

This soil is suited to range. It is highly susceptible to soil blowing if the plant cover is removed. The native grasses are blue grama, prairie sandreed, little bluestem, and switchgrass. If the range is overgrazed, the amount of less desirable plants, such as sand dropseed, sand sagebrush, small soapweed, and other perennial grasses and shrubs, increases. Management that maintains an adequate plant cover and ground mulch reduces the runoff rate, increases the rate of water infiltration, and helps to prevent excessive soil loss. A planned grazing system that includes a proper stocking rate and a uniform distribution of grazing helps to keep the range productive. Properly located salting facilities help to distribute grazing more evenly.

This soil is well suited to dwellings and septic tank absorption fields. It is generally unsuited to sewage lagoons because of seepage.

The land capability classification is IVe, nonirrigated, and IIIe, irrigated. The range site is Sandy.

Mh—Midway clay, 5 to 20 percent slopes. This shallow, moderately sloping to moderately steep, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is grayish brown, calcareous clay about 4 inches thick. The substratum is grayish brown, calcareous clay. Light brownish gray, calcareous, clayey shale bedrock is at a depth of about 12 inches.

Included with this soil in mapping are small areas of Colby and Razor soils. The deep Colby soils are on the upper side slopes. The moderately deep Razor soils are on the less sloping side slopes. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Midway soil, and available water capacity is very low. Surface runoff is rapid. The surface layer is mildly alkaline. Root development is restricted below a depth of about 12 inches. Natural fertility and organic matter content are low. The shrink-swell potential is high.

Nearly all areas are used as range. Because erosion is a severe hazard, this soil is generally unsuited to cultivated crops. It is best suited to range. The native grasses are dominantly sideoats grama, green needlegrass, and western wheatgrass. If the range is overgrazed, the more desirable grasses are replaced by less productive grasses and by weeds. Water erosion is a hazard unless a protective plant cover is maintained. An adequate plant cover reduces the runoff rate, helps to prevent excessive soil loss, and increases the moisture supply. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Properly located salting facilities help to distribute grazing more evenly. The larger areas include some soils that are suitable for stock water ponds. Some areas are suitable for the development of springs.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by the shrinking and swelling. The depth to bedrock is a limitation on sites for

dwellings with basements, but the shale is soft and can be excavated.

Because of the depth to bedrock, this soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. Fill material should be borrowed or the bedrock ripped during the construction of lagoons. Sealing the bottom of the lagoon helps to prevent excessive seepage through fractures in the bedrock. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is VIe, nonirrigated. The range site is Shale Breaks.

Po—Pleasant silty clay loam. This deep, nearly level, moderately well drained soil is in upland depressions. It is frequently ponded in fall and spring. Individual areas are irregular in shape and range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 5 inches thick. The subsoil is about 47 inches thick. It is grayish brown. The upper part is firm silty clay loam, the next part is extremely firm silty clay, and the lower part is firm silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam.

Permeability is very slow, and surface runoff is ponded. Available water capacity is moderate. Natural fertility is high, and organic matter content is medium. The surface layer is neutral. Tilth is fair. The shrink-swell potential is high in the subsoil.

Nearly all areas are cultivated along with the surrounding areas. Wheat and sorghum are the main crops. Because of the ponding, this soil is poorly suited to cultivated crops. Stubble mulching, terraces, and contour farming on the surrounding soils help to control the ponding on this soil. Soil blowing is a hazard during dry periods. It can be controlled by minimum tillage and stubble mulching.

The ponding on this soil results in shallow water areas that can be used as habitat by waterfowl and other kinds of wildlife. The cultivated crops in the adjacent areas supply food and nesting areas.

This soil generally is unsuited to building site development because of the ponding.

The land capability classification is IVw, nonirrigated and irrigated. The range site is Clay Upland.

Rc—Razor clay, 1 to 6 percent slopes. This moderately deep, gently sloping and moderately sloping, well drained soil is on side slopes and ridgetops in the uplands. Individual areas are irregular in shape and range from 10 to 160 acres in size.

Typically, the surface layer is grayish brown, calcareous clay about 6 inches thick. The subsoil is calcareous clay about 18 inches thick. The upper part is grayish brown and very firm, and the lower part is light brownish gray and extremely firm. The substratum is light gray, calcareous clay. Light olive gray, clayey shale bedrock is at a depth of about 32 inches.

Included with this soil in mapping are small areas of Colby and Midway soils. The deep Colby soils are on ridgetops or the upper side slopes. The shallow Midway soils are on the steeper side slopes. Included soils make up about 5 percent of the map unit.

Permeability is slow in the Razor soil, and available water capacity is low. Surface runoff is rapid. Organic matter content and natural fertility are low. The surface layer is moderately alkaline. Tilth is poor. Root development is restricted below a depth of about 32 inches. The shrink-swell potential is high.

Nearly all areas are used as range. Because of a severe hazard of erosion and the low fertility and available water capacity, this soil is poorly suited to cultivated crops. It is suited to range. The native vegetation is alkali sacaton, western wheatgrass, and blue grama. If the range is overgrazed, the more desirable grasses are replaced by less productive grasses and the runoff rate is increased. Water erosion is a hazard unless a protective plant cover is maintained. A proper stocking rate, a scheduled deferment of grazing during the growing season, and a uniform distribution of grazing help to keep the range productive.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling.

Because of the slow permeability and the depth to bedrock, this soil is generally unsuited to septic tank absorption fields. It is only moderately well suited to sewage lagoons because of the depth to bedrock. Fill material should be borrowed or the bedrock ripped during the construction of lagoons. Sealing the bottom of the lagoon helps to prevent excessive seepage through fractures in the bedrock.

The land capability classification is IVe, nonirrigated and irrigated. The range site is Clay Upland.

Sc—Satanta loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on upland ridgetops and side slopes. Individual areas are irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is grayish brown loam about 6 inches thick. The subsurface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is about 22 inches thick. The upper part is pale brown, friable clay loam, and the lower part is very pale brown, friable, calcareous loam. The substratum to a depth of about 60 inches is very pale brown, calcareous loam. In some areas the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Ulysses and Manter soils. Manter soils are on mounds and side slopes. They are more sandy than the Satanta soil. The silty Ulysses soils are in the slightly lower areas. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Satanta soil, and surface runoff is medium. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. The surface layer is neutral. It is friable. Tilth is good.

Most areas are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, and pasture grasses. Forage crops, grain sorghum, and alfalfa are the principal irrigated crops. If cultivated crops are grown, erosion is a hazard in the more sloping areas. Terraces, contour farming, and minimum tillage help to prevent excessive soil loss and conserve moisture. Returning crop residue to the soil helps to maintain the organic matter content, fertility, and good tilth.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because seepage and slope are limitations. Sealing the floor of the lagoon helps to control seepage. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Loamy Upland.

Se—Sweetwater clay loam, occasionally flooded. This deep, nearly level, poorly drained soil is on flood plains along the major streams. Individual areas are long and narrow and range from 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown, calcareous clay loam about 10 inches thick. The subsurface layer is grayish brown, mottled, firm, calcareous clay loam about 4 inches thick. The substratum to a depth of about 60 inches is calcareous and mottled. The upper part is light brownish gray clay loam, the next part is very pale brown loamy fine sand, and the lower part is very pale brown sand.

Included with this soil in mapping are small areas of the moderately well drained Caruso soils on the slightly higher flood plains. Also included are small areas of saline soils. Included soils make up about 10 percent of the map unit.

Permeability is moderately slow in the upper part of the Sweetwater soil and rapid in the lower part. Surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. A seasonal high water table is at a depth of 0.5 to 3.0 feet. The surface layer is moderately alkaline.

Most areas are used as range. Because of the flooding, this soil is generally unsuited to cultivated crops. It is suited to range. The native vegetation is dominantly big bluestem, switchgrass, and indiangrass. Trees and shrubs also are common. Cattle tend to congregate around watering facilities and shade trees. As a result, many areas are overgrazed and the more desirable grasses have been replaced by less productive grasses and by weeds. Overused areas are dominated by inland saltgrass, sedges, and western wheatgrass. Locating salt blocks on the steeper adjacent soils helps to distribute grazing more evenly. Some areas are meadows managed for native hay.

The vegetation commonly growing on this soil provides habitat for many kinds of wildlife, including deer, wild turkey, and pheasants. The wildlife population can be increased by increasing the number of fringe areas where woodland is adjacent to cropland.

This soil is generally unsuited to building site development because of the flooding and the wetness.

The land capability classification is Vw, nonirrigated. The range site is Subirrigated.

Ua—Ulysses silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is in broad areas on the summits of uplands. Individual areas are irregular in shape and range from 60 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is calcareous. In other areas the depth to calcareous material is more than 15 inches.

Permeability is moderate, and surface runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is mildly alkaline. Tilth is good. The shrink-swell potential is moderate in the subsoil.

About 60 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. In some areas sorghum is susceptible to chlorosis because of a high content of lime in the soil. Measures that help to control soil blowing and conserve moisture are the main management needs. Examples are summer fallowing, contour farming, and conservation tillage systems that leave crop residue on the surface (fig. 7).

Some areas are irrigated by gravity flow or by sprinklers. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The major management concerns are maintenance of fertility and the efficient use of irrigation water. Conservation tillage helps to maintain the organic matter content, tilth, and fertility.

This soil is suited to range. The dominant native vegetation is blue grama, western wheatgrass,

Figure 7.—Wheat stubble in an area of Ulysses silt loam, 0 to 1 percent slopes.

buffalograss, and sideoats grama. If the range is overgrazed, the more desirable grasses and forbs are replaced by less productive plants. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Well distributed salting and watering facilties help to obtain a uniform distribution of grazing.

This soil is well suited to dwellings and septic tank absorption fields. The shrink-swell potential, however, is a limitation on sites for dwellings without basements. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor of the lagoon.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Loamy Upland.

Ub—Ulysses silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on convex ridgetops and the upper side slopes and along drainageways in the uplands. Individual areas are long and wide and range from 40 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is calcareous.

Permeability is moderate, and surface runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is mildly alkaline. Tilth is good. The shrink-swell potential is moderate in the subsoil.

About 50 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to nonirrigated crops and is well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. In some areas sorghum is susceptible to chlorosis because of a high content of lime in the soil. Measures that help to control erosion and conserve moisture are the main management needs. Examples are summer fallowing, terraces (fig. 8), contour farming, and stubble mulching.

Some areas are irrigated, mainly by sprinklers (fig. 9). Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The major management needs are measures that help to control erosion and maintain fertility and the efficient use of irrigation water. Conservation tillage systems that keep crop residue on the surface help to maintain the organic matter content, tilth, and fertility and help to control erosion. Terraces and contour farming also help to control erosion.

This soil is suited to range. The dominant native grasses are blue grama, western wheatgrass,

Figure 8.—A level terrace in an area of Ulysses silt loam, 1 to 3 percent slopes.

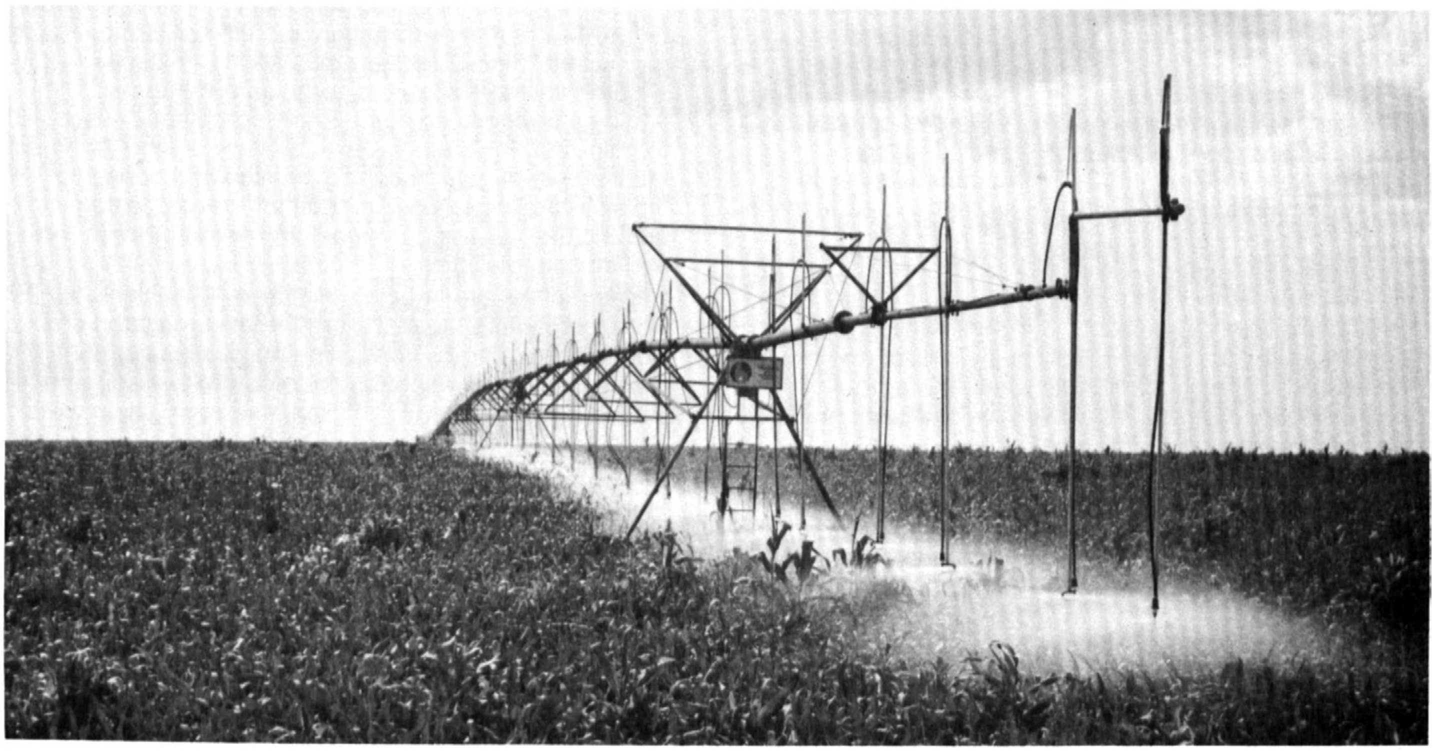

Figure 9.—Sprinkler irrigation in an area of Ulysses silt loam, 1 to 3 percent slopes.

buffalograss, and sideoats grama. If the range is overgrazed, the more desirable grasses and forbs are replaced by less productive plants. Water erosion is a hazard unless a protective plant cover is maintained. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Well distributed salting and watering facilities help to obtain a uniform distribution of grazing.

This soil is well suited to dwellings and septic tank absorption fields. The shrink-swell potential, however, is a limitation on sites for dwellings without basements. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. Seepage and slope are limitations on sites for sewage lagoons. Sealing the floor of the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Loamy Upland.

Uc—Ulysses silt loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil is on the upper side slopes along drainageways in the uplands. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is grayish brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is calcareous.

Permeability is moderate, and surface runoff is medium. Available water capacity and natural fertility are low. Organic matter content is moderate. The surface layer is mildly alkaline. Tilth is good. The shrink-swell potential is moderate in the subsoil.

About 40 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is poorly suited to nonirrigated crops and is only moderately well suited to irrigated crops because of the slope and the runoff rate. Wheat and grain sorghum are the main nonirrigated crops. Sorghum is susceptible to chlorosis because of a high content of lime in the soil. Measures that help to control erosion and conserve moisture are the main management needs. Examples are summer fallowing, terraces, contour farming, and stubble mulching.

Some areas are irrigated, mainly by sprinklers. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The major management needs are measures that help to control erosion and maintain

fertility and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the organic matter content, tilth, and fertility and help to control erosion. Terraces and contour farming help to prevent excessive soil loss and runoff.

This soil is suited to range. The dominant native vegetation is blue grama, western wheatgrass, sideoats grama, and buffalograss. If the range is overgrazed, the more desirable grasses and forbs are replaced by less productive plants. A proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season help to keep the range productive. Well distributed salting and watering facilities help to obtain a uniform distribution of grazing.

This soil is well suited to dwellings and septic tank absorption fields. The shrink-swell potential, however, is a limitation on sites for dwellings without basements. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. The soil is only moderately well suited to sewage lagoons because seepage and slope are limitations. Sealing the floor of the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IVe, nonirrigated, and IIIe, irrigated. The range site is Loamy Upland.

Us—Ulysses-Colby complex, 1 to 4 percent slopes. These deep, gently sloping, well drained soils are on undulating uplands. The Ulysses soil is on the lower side slopes, and the calcareous Colby soil is on mounds or the upper slopes. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 60 percent Ulysses soil and 20 percent Colby soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Ulysses soil has a grayish brown silt loam surface layer about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 4 inches thick. The subsoil is dark grayish brown, friable silt loam about 9 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer and subsoil are loam.

Typically, the Colby soil has a grayish brown, calcareous loam surface layer about 4 inches thick. The next layer is light brownish gray, friable, calcareous loam about 6 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some eroded areas the surface layer is very pale brown.

Included with these soils in mapping are small areas of Goshen and Kim soils, which make up about 20 percent of the map unit. Goshen soils have a thick, dark surface layer. They are in swales. The loamy Kim soils are on the upper side slopes or knobs near the Colby soil.

Permeability is moderate in the Ulysses and Colby soils. Surface runoff is medium. Available water capacity is high. Natural fertility is high in the Ulysses soil and medium in the Colby soil. Organic matter content is moderate in the Ulysses soil and low in the Colby soil. The surface layer of the Ulysses soil is mildly alkaline, and that of the Colby soil is moderately alkaline. The shrink-swell potential is moderate in the subsoil of the Ulysses soil.

Most of the acreage is used for cultivated crops. The rest is used as range. These soils are moderately well suited to nonirrigated crops and are well suited to irrigated crops. Wheat and sorghum are the main nonirrigated crops. Sorghum is susceptible to chlorosis because of a high content of lime in the Colby soil. Measures that help to control erosion and conserve moisture are the main management needs. Examples are summer fallowing, wind stripcropping, and stubble mulching. Terracing is generally not practical because of the irregular and undulating topography.

Some areas are irrigated, mainly by sprinklers. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The major management needs are measures that help to control erosion and maintain fertility and the efficient use of irrigation water. Conservation tillage systems that leave crop residue on the surface help to maintain the organic matter content and fertility and help to prevent excessive soil loss.

These soils are suited to range. The native grasses dominantly are sideoats grama, blue grama, western wheatgrass, and buffalograss. If the range is overgrazed, the more desirable grasses and forbs are replaced by less productive plants, such as tall dropseed and small soapweed. Water erosion is a hazard unless a protective plant cover is maintained. Properly distributed watering and salting facilities and properly located fences improve the distribution of grazing. A proper stocking rate, a uniform grazing distribution, and a scheduled deferment of grazing during the growing season help to keep the range productive. Range seeding is needed to restore the productivity of abandoned cropland.

These soils are well suited to dwellings and septic tank absorption fields. The shrink-swell potential of the Ulysses soil, however, is a limitation on sites for dwellings without basements. Properly designing and reinforcing foundations can help to prevent the structural damage caused by shrinking and swelling. Both soils are only moderately well suited to sewage lagoons because seepage and slope are limitations. Sealing the floor of the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The Ulysses soil is in the Loamy Upland range site, and the Colby soil is in the Limy Upland range site.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

If irrigated, about 85,000 acres in the survey area, or nearly 15 percent of the total acreage, meets the soil requirements for prime farmland. Most of the prime farmland is in the western part of the county and along the larger stream valleys.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have limitations, such as a seasonal high water table, frequent flooding during the growing season, or inadequate rainfall, qualify for prime farmland only in areas where these limitations have been overcome by such measures as drainage, flood control, or irrigation. The soils considered prime farmland in Wallace County qualify as prime farmland only in areas where they are irrigated. Onsite evaluation is needed to determine whether or not a lack of sufficient rainfall has been overcome by irrigation.

In irrigated areas the following map units meet the soil requirements for prime farmland:

Bo	Bridgeport loam, occasionally flooded
Bp	Bridgeport silt loam, 0 to 2 percent slopes
Br	Bridgeport silt loam, 2 to 6 percent slopes
Ch	Caruso loam, occasionally flooded
Co	Colby silt loam, 3 to 6 percent slopes
Go	Goshen silt loam
Ke	Keith silt loam, 0 to 1 percent slopes
Ku	Kuma silt loam, 0 to 1 percent slopes
Sc	Satanta loam, 1 to 3 percent slopes
Ua	Ulysses silt loam, 0 to 1 percent slopes
Ub	Ulysses silt loam, 1 to 3 percent slopes
Uc	Ulysses silt loam, 3 to 6 percent slopes
Us	Ulysses-Colby complex, 1 to 4 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to a land capability classification and a range site at the end of each map unit description and in tables 5 and 6. The interpretive groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops

John C. Dark, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Approximately 52 percent of the acreage in Wallace County is used for cultivated crops or is summer fallowed. During the period 1971 to 1981, wheat was grown on about 37 percent of the cropland, corn on 13 percent, and sorghum on 4 percent. About 18 percent was unharvested or was used for minor crops, such as alfalfa, sugar beets, dry beans, and sunflowers (fig. 10). About 28 percent of cropland was summer fallowed (*3*).

The acreage used for sugar beets decreased during the period 1971 to 1981, while the acreage used for wheat and corn increased. The acreage used for sorghum remained fairly constant. The acreage of irrigated land increased to 87,000 acres in 1981.

On most farms crop production can be increased by the latest crop production technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in the county for crops are controlling water erosion and soil blowing, making the most efficient use of the water available to plants, and maintaining soil fertility.

Water erosion is the major problem on about 46 percent of the cropland in the county. Soil blowing is a hazard on most soils unless an adequate vegetative cover is maintained. Inadequate rainfall is a problem on all of the cropland. Water erosion is a hazard if the slope is more than 2 percent. The arable soils in the county that have a slope of more than 2 percent are Bridgeport, Colby, Elkader, Manter, Razor, Satanta, and Ulysses

Figure 10.—An area in Wallace County used for sunflowers.

soils. Erosion reduces the productivity of the soil. If the surface layer is lost through erosion, most plant nutrients and organic matter, which have a positive effect on soil structure, water infiltration, available water capacity, and tilth, are lost. In many areas erosion on farmland results in the pollution of streams by sediment, nutrients, and pesticides. Controlling erosion minimizes this pollution and improves the quality of the water.

Erosion control provides a protective cover of plants or crop residue, reduces the runoff rate, and increases the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soil.

Conservation tillage systems that leave crop residue on the surface, terraces and diversions, contour farming, and cropping systems in which drilled crops are alternated with row crops help to control erosion on cropland. Conservation tillage, which is effective in controlling both soil blowing and water erosion, is used on an increasing acreage in Wallace County. Terraces and diversions shorten the length of slopes and thus reduce the runoff rate and the susceptibility to erosion. They are most practical on deep, well drained soils that have uniform, regular slopes. Most of the arable soils in the county have those characteristics. Measures that reduce the runoff rate and minimize soil blowing help to maintain tilth and increase the rate of water infiltration.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils the amount of fertilizer needed should be determined by the results of soil tests, the needs of the crop, the expected level of yields, and the experience of farmers. The Cooperative Extension Service can help to determine the kind and amount of fertilizer needed.

Organic matter is a storehouse of available nutrients in the soil. Also, it increases the water intake rate, helps to prevent surface crusting, reduces the susceptibility to erosion, and promotes good tilth. Most of the arable soils in the county have a silt loam surface layer. A surface crust forms during periods of intensive rainfall.

When dry, the crust increases the runoff rate because it becomes nearly impervious to water. Regularly adding organic matter to the soil and leaving crop residue on the surface help to prevent surface crusting.

Information about erosion-control practices and other management practices for each kind of soil can be obtained at the local office of the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Figure 11.—An area of Ulysses soils used as rangeland.

Rangeland

Loren J. Pearson, range conservationist, Soil Conservation Service, helped prepare this section.

Approximately 273,000 acres in Wallace County, or nearly 47 percent of the total acreage, is rangeland (fig. 11). The county has an estimated 18,500 head of livestock. Cow-calf herds are common, but some herds consist of stocker-type cattle. The rangeland in the county is well suited to these livestock programs. It is in all areas of the county, but it is dominantly adjacent to the major streams and in areas of the steeper soils.

Essentially all of the grass species on the rangeland are the same as those of 100 years ago. Changes have occurred, however, because of environmental and cultural influences. In general, tall and mid grasses are in the lower areas and on favored sites, whereas short grasses are in the upland areas. Nearly all of the grasses, regardless of their location, are excellent for grazing. The cool-season grasses, such as western wheatgrass, provide good early season growth and abundant nutritious forage. As the cool-season plants reach maturity, the warm-season plants, such as blue grama and sideoats grama, continue to grow profusely. An abundance of forbs also is evident on most of the rangeland. Under heavy grazing pressure, several minor but poisonous plants can become troublesome. Broom snakeweed (*Gutierrezia sarothrae*) is one that commonly occurs on soils that are limy throughout. Another plant is Riddell groundsel (*Senecio riddelli*). Neither of these plants should cause problems unless livestock are forced to graze them because of a lack of other grazable forage.

Although fourwing saltbush is not available in large quantities, it is a highly desirable winter grazing shrub. It grows best in mildly alkaline soils. Wallace County is

among the two or three counties in Kansas where this plant is known to remain in some areas of native grasses.

Most of the rangeland is grazed from mid-May through mid-October. Some areas, however, are grazed year round. Supplementing the native forage with protein, especially during periods just before and after calving, is highly desirable in these areas. On some ranches crop aftermath, such as milo or wheat stubble, is used to cut the cost of maintaining herds and to reduce the amount of grass needed for grazing.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants (fig. 12). The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of

Figure 12.—An area of rangeland assigned to the Shallow Limy range site. Total grass production is low, but the site produces a good variety of forage grasses.

air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Native Woodland, Windbreaks, and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

Wallace County has very little native woodland. The wooded areas are confined to narrow bands along the major streams in areas of the Bridgeport-Bankard soil association, which is described under the heading "General Soil Map Units." Areas along the Smoky Hill River support clumps of trees all across the county, except for the western part. Plains cottonwood and peachleaf willow are the dominant species. Few upland drainageways support trees. Individual trees or small clumps of trees, generally plains cottonwood or hackberry, are in wet spots in the canyons. Fragrant sumac commonly grows along the edges of the canyons.

The wooded areas are a valuable source of firewood, but they are too small to be of commercial value for other wood products. Only a few of the trees planted for tree claims during the settlement of Wallace County have survived.

On most farmsteads and ranch headquarters in the county, windbreaks and environmental plantings have been established at various times by landowners. The most common species are Siberian elm, eastern redcedar, and lilac, but other species include Rocky Mountain juniper, honeylocust, green ash, hackberry, Austrian pine, ponderosa pine, Scotch pine, Russian-olive, and various fruit trees.

Tree planting on farmsteads and ranch headquarters is a continuing need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, diseases, or storms, and because new plantings are needed in areas where farming or ranching is expanding. Measures that renovate windbreaks, such as removing and replacing trees or supplemental planting, are needed to provide effective protection against the wind and to control snow (fig. 13).

In order for windbreaks to fulfill their intended purpose, the trees and shrubs selected for planting should be suited to the soils on the site. Selecting suitable species helps to ensure survival and a maximum growth rate. Permeability, available water capacity, fertility, soil depth, and texture greatly affect the growth rate.

Establishing trees and shrubs in Wallace County is difficult because of a lack of sufficient moisture. The survival rate generally is restricted by dry conditions and by competition from weeds and grasses. Proper site preparation before planting and control of competing vegetation after planting are the main concerns in establishing and maintaining windbreaks. Supplemental watering is necessary to provide moisture during dry periods.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Figure 13.—Drifting snow controlled by a well managed windbreak.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Several areas in Wallace County are of scenic, geologic, and historic interest. Mt. Sunflower, which is on the west side of the county, near the Colorado border, is the highest point in Kansas, 4,039 feet above sea level. The old Fort Wallace, the Butterfield Trail, and Old Maids Pool are other points of interest. Rock bluffs, rolling cropland, and short grass prairies provide a scenic landscape inhabited by antelope, deer, and prairie dogs.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Wallace County are pheasant, cottontail rabbit, mule deer, and antelope. Antelope hunting is unique to this part of the state. All hunting is on privately owned land.

Nongame species, such as prairie dogs, hawks, swift fox, and coyotes, are well adapted to the climate in Wallace County (fig. 14). Planting a permanent cover of trees, shrubs, and native grasses and forbs would add vegetative diversity and thus would increase the wildlife population.

Figure 14.—A prairie dog in an area of Ulysses soils used as range.

A few farm ponds have been stocked with channel catfish, bass, and bluegill. Fishing is seasonally good or fair.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be

established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, grain sorghum, and oats.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, sunflowers, ragweed, wheatgrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are plum, fragrant sumac, and prairie rose.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattails, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, swift fox, field sparrow, and cottontail.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, and muskrat.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelopes, deer, prairie dogs, meadowlarks, and hawks.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John Eberwein, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this

section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be

expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil

and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

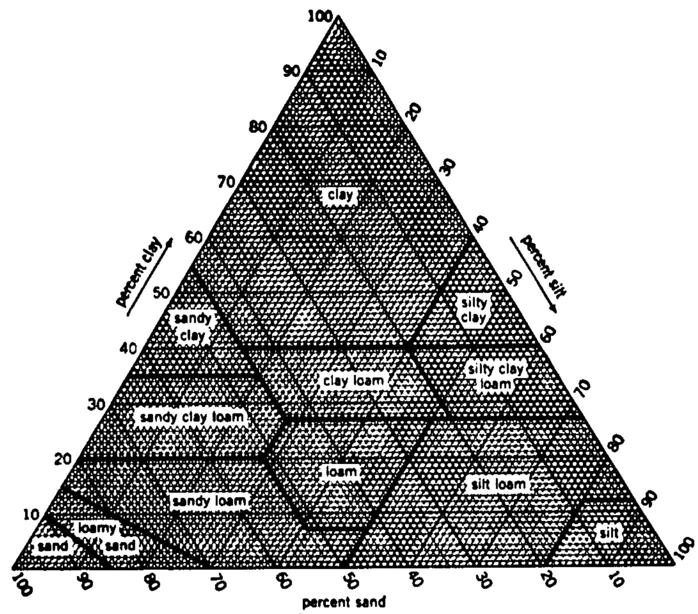

Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in

group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type

of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or

soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey

area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aridic* identifies the subgroup that is drier than is typical for the great group. An example is Aridic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Aridic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*5*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Arvada Series

The Arvada series consists of deep, well drained, very slowly permeable soils on stream terraces and alluvial fans. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 2 percent.

Arvada soils are commonly adjacent to Bridgeport, Caruso, and Sweetwater soils. The silty Bridgeport soils are less clayey than the Arvada soils and have a lower content of sodium salts. They are on the slightly higher parts of the landscape. The somewhat poorly drained Caruso and poorly drained Sweetwater soils are on the lower flood plains.

Typical pedon of Arvada loam, in an area of Bridgeport-Arvada complex, 930 feet north and 235 feet west of the southeast corner of sec. 31, T. 12 S., R. 40 W.

E—0 to 2 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; slightly hard, very friable; mildly alkaline; about 20 percent exchangeable sodium; abrupt smooth boundary.

Bt—2 to 8 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium columnar structure; hard, firm; strong effervescence in the lower 4 inches; strongly alkaline; about 35 percent exchangeable sodium; clear smooth boundary.

Bty—8 to 22 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; common threads of gypsum; strong effervescence; moderately saline; strongly alkaline; about 40 percent exchangeable sodium; gradual smooth boundary.

BCy—22 to 43 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, firm; many threads and coatings of gypsum; strong effervescence; moderately saline; strongly alkaline; about 36 percent exchangeable sodium; gradual smooth boundary.

C—43 to 60 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few coatings of gypsum; strong effervescence; slightly saline; strongly alkaline; about 40 percent exchangeable sodium.

The depth to lime ranges from 0 to 12 inches. Some pedons have a thin A horizon.

The E horizon has hue of 2.5Y or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It ranges from neutral to strongly alkaline. The Bt and Bty horizons have hue of 2.5Y to 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. They are silty clay or silty clay loam. The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4.

Bankard Series

The Bankard series consists of deep, somewhat excessively drained, rapidly permeable soils on stream terraces and flood plains. These soils formed in sandy and loamy alluvium. Slope ranges from 0 to 2 percent.

Bankard soils are commonly adjacent to Bridgeport and Caruso soils. The silty Bridgeport soils have a mollic epipedon and are more silty than the Bankard soils. They are on the slightly higher flood plains and stream terraces. The somewhat poorly drained Caruso soils are on the slightly lower flood plains. They have a mollic epipedon.

Typical pedon of Bankard sandy loam, 700 feet north and 500 feet east of the center of sec. 14, T. 13 S., R. 41 W.

A—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; about 5 percent gravel; common fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

AC—5 to 12 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 4/3) moist; single grained; loose; about 5 percent gravel; few fine roots; strong effervescence; mildly alkaline; clear wavy boundary.

C—12 to 60 inches; very pale brown (10YR 7/3) sand, yellowish brown (10YR 5/4) moist; a few thin strata of dark grayish brown sandy loam; single grained; loose; about 15 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 5 to 20 inches. The A horizon has hue of 2.5Y to 7.5YR, value 5 or 6 (3 to 5 moist), and chroma of 2 to 4. It is typically sandy loam or loamy sand, but the range includes sand. The C horizon has hue of 2.5Y to 7.5YR, value of 6 or 7 (4 or 5 moist), and chroma of 3 or 4. It is dominantly fine sand, sand, or gravelly sand but has a few loamy strata.

Bridgeport Series

The Bridgeport series consists of deep, well drained, moderately permeable soils on stream terraces, flood plains, and alluvial fans. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 6 percent.

Bridgeport soils are similar to Goshen soils and are commonly adjacent to Bankard, Caruso, Colby, Goshen, and Kim soils. The somewhat excessively drained Bankard soils are on the lower flood plains. They are more sandy than the Bridgeport soils. The somewhat poorly drained Caruso soils are on flood plains. Colby and Kim soils are on uplands. They do not have a mollic epipedon. Also, Colby soils have a silty subsoil, and Kim soils have a loamy subsoil. Goshen soils have a mollic epipedon that is more than 20 inches thick.

Typical pedon of Bridgeport silt loam, 0 to 2 percent slopes, 1,500 feet north and 200 feet east of the southwest corner of sec. 27, T. 13 S., R. 40 W.

A—0 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; many fine roots; few worm casts; slight effervescence in the upper 4 inches and strong

effervescence in the lower part; moderately alkaline; gradual smooth boundary.

Bw—12 to 24 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—24 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable; common fine roots; few fine pores; few thin strata of sandy loam and few dark grayish brown strata; few threads and films of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 30 inches. The depth to lime ranges from 0 to 15 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly silt loam or loam, but the range includes fine sandy loam, clay loam, and silty clay loam. The Bw horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silt loam, silty clay loam, or loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is loam, silt loam, or silty clay loam. More sandy or clayey strata, mottles, and buried soils are below a depth of 40 inches in some pedons.

Canyon Series

The Canyon series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in loamy, calcareous material weathered from weakly cemented limestone or very fine grained sandstone. Slope ranges from 5 to 30 percent.

Canyon soils are commonly adjacent to Colby, Kim, and Ulysses soils. The adjacent soils are more than 40 inches deep over bedrock. Colby and Ulysses soils are higher on the landscape than the Canyon soils. Kim soils are on side slopes both above and below the Canyon soils.

Typical pedon of Canyon loam, 5 to 30 percent slopes, about 100 feet west and 50 feet north of the southeast corner of sec. 12, T. 14 S., R. 39 W.

A—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; about 5 percent caliche fragments 2 to 20 millimeters in diameter; violent effervescence; mildly alkaline; abrupt smooth boundary.

AC—4 to 8 inches; light brownish gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate fine granular; soft, friable; about 20 percent caliche fragments 2 to 20 millimeters in diameter; violent effervescence; moderately alkaline; clear smooth boundary.

C—8 to 14 inches; very pale brown (10YR 8/3) gravelly loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; about 25 percent caliche fragments 2 to 30 millimeters in diameter; violent effervescence; moderately alkaline; abrupt wavy boundary.

Cr—14 inches; very pale brown (10YR 8/3) weakly cemented fine grained sandstone and some hard caliche; violent effervescence.

The solum is 6 to 12 inches thick. The depth to bedrock ranges from 6 to 20 inches. Reaction is mildly alkaline or moderately alkaline above the bedrock. The content of coarse fragments ranges from 0 to 25 percent above the bedrock.

The A horizon has hue of 10YR, value of 4 to 7 (3 to 6 moist), and chroma of 2 or 3. It is dominantly loam, but the range includes gravelly loam and gravelly sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (4 to 7 moist), and chroma of 2 to 4.

Caruso Series

The Caruso series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Caruso soils are commonly adjacent to Bankard, Bridgeport, and Sweetwater soils. The somewhat excessively drained Bankard soils are on the higher flood plains. They are more sandy than the Caruso soils. The well drained Bridgeport soils are on the slightly higher stream terraces. They have a silty subsoil. The poorly drained Sweetwater soils are on the lower flood plains. They are underlain by sandy material at a depth of 10 to 30 inches.

Typical pedon of Caruso loam, occasionally flooded, 100 feet west and 50 feet north of the center of sec. 9, T. 14 S., R. 39 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

A2—6 to 16 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—16 to 32 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; few fine distinct strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable; few fine roots; strong

effervescence; moderately alkaline; gradual smooth boundary.

C2—32 to 42 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; few fine faint brown (10YR 5/3) mottles; massive; hard, friable; few fine roots; violent effervescence; moderately alkaline; gradual smooth boundary.

C3—42 to 60 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; common fine faint yellowish brown (10YR 5/4) mottles; massive; few thin strata of loamy sand; hard, friable; few fine roots; violent effervescence; moderately alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 10 to 20 inches. The depth to lime ranges from 0 to 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam, silty clay loam, and sandy loam. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 1 to 3. It is dominantly loam, silt loam, or clay loam. In some pedons, however, contrasting sandy or clayey strata are below a depth of 40 inches.

Colby Series

The Colby series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 1 to 15 percent.

Colby soils are similar to Ulysses soils and are commonly adjacent to Canyon, Kim, Midway, and Ulysses soils. All of the adjacent soils, except for Ulysses soils, are lower on the landscape than the Colby soils. Ulysses soils have a mollic epipedon. Canyon soils are 10 to 20 inches deep over bedrock. Midway soils are shallow over clayey shale bedrock. Kim soils contain more sand in the subsoil than the Colby soils.

Typical pedon of Colby silt loam, 3 to 6 percent slopes, about 1,000 feet east and 150 feet north of the southwest corner of sec. 24, T. 14 S., R. 40 W.

A—0 to 5 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard; friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

AC—5 to 11 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—11 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; few fine roots; common fine lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

The solum is 3 to 12 inches thick. Typically, lime is throughout the profile, but some pedons do not have lime in the upper 6 inches. All horizons are silt loam or loam and are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. The AC and C horizons have hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Elkader Series

The Elkader series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, silty sediments weathered from chalky limestone and in loess. Slope ranges from 2 to 6 percent.

Elkader soils are commonly adjacent to Bridgeport, Colby, and Ulysses soils. Bridgeport soils are on stream terraces that are subject to rare flooding. Colby and Ulysses soils are on uplands. Colby soils do not have a mollic epipedon. Ulysses soils do not have lime in the A horizon.

Typical pedon of Elkader silt loam, 2 to 6 percent slopes, 1,300 feet south and 500 feet west of the northeast corner of sec. 36, T. 13 S., R. 38 W.

A—0 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; about 3 percent soft chalk fragments 2 to 10 millimeters in diameter; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw—10 to 18 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate fine granular structure; slightly hard, friable; many fine roots; about 5 percent soft chalk fragments 2 to 10 millimeters in diameter; violent effervescence; moderately alkaline; clear smooth boundary.

C1—18 to 29 inches; very pale brown (10YR 7/4) silt loam, brownish yellow (10YR 6/6) moist; massive; slightly hard, friable; few fine roots; about 5 percent chalk fragments 2 to 10 millimeters in diameter; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—29 to 60 inches; light yellowish brown (10YR 6/4) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few fine roots; about 5 percent chalk fragments 2 to 10 millimeters in diameter; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 32 inches. The mollic epipedon is 7 to 20 inches thick. The texture is silt loam or silty clay loam throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 6. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 3 to 6. It is moderately alkaline or strongly alkaline.

Glenberg Series

The Glenberg series consists of deep, well drained, moderately rapidly permeable soils on stream terraces. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Glenberg soils are commonly adjacent to Bankard, Bridgeport, and Caruso soils. Bankard soils have a sandy subsoil. They are on the slightly lower flood plains. Bridgeport soils have a silty subsoil. They are in positions on the landscape similar to those of the Glenberg soils. The somewhat poorly drained Caruso soils are on the slightly lower flood plains. They have a mollic epipedon.

Typical pedon of Glenberg sandy loam, 2,900 feet east and 400 feet south of the northwest corner of sec. 31, T. 13 S., R. 38 W.

A—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, friable; few fine roots; about 5 percent gravel; slight effervescence; moderately alkaline; abrupt smooth boundary.

AC—5 to 15 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, friable; few fine roots; about 2 percent gravel; strong effervescence; moderately alkaline; gradual smooth boundary.

C—15 to 30 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; massive; soft, friable; about 3 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

Akb—30 to 40 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; massive; soft, friable; few fine and medium fragments (about 1 percent); strong effervescence; common films and threads of lime; moderately alkaline; clear smooth boundary.

2C—40 to 60 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; gravelly loamy sand strata; massive; soft, very friable; strong effervescence; moderately alkaline.

The depth to lime is less than 10 inches, and most pedons are calcareous to the surface. The A horizon has hue of 2.5Y or 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. It is dominantly sandy loam, but the range includes loamy sand, loamy fine sand, and fine sandy loam. The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3.

Goshen Series

The Goshen series consists of deep, well drained, moderately permeable soils in swales and narrow drainageways on uplands. These soils formed in silty alluvium. Slope ranges from 0 to 3 percent.

Goshen soils are similar to Bridgeport and Kuma soils and are commonly adjacent to Bridgeport, Colby, and Ulysses soils. Bridgeport and Ulysses soils have a mollic epipedon that is less than 20 inches thick. Kuma soils are 14 to 35 inches deep to lime. Colby and Ulysses soils are higher on the landscape than the Goshen soils. Colby soils do not have a mollic epipedon.

Typical pedon of Goshen silt loam, 2,400 feet south and 100 feet west of the northeast corner of sec. 31, T. 13 S., R. 41 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

A2—8 to 16 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

Bt1—16 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; common fine roots; thin continuous films on peds; neutral; gradual smooth boundary.

Bt2—30 to 39 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm; common fine roots; thin continuous films on peds; mildly alkaline; gradual smooth boundary.

C1—39 to 48 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; few fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—48 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard; friable; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to lime range from 35 to 60 inches. The thickness of the mollic epipedon ranges from 20 to 32 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam. This horizon ranges from slightly acid to mildly alkaline. The Bt horizon has hue of 10YR, value of 4 to 6 (2 to 5 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The C horizon has hue

of 10YR or 2.5Y, value of 6 to 8 (4 to 6 moist), and chroma of 2 or 3. It is silt loam or loam.

Keith Series

The Keith series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope is 0 to 1 percent.

Keith soils are similar to Kuma, Satanta, and Ulysses soils and are commonly adjacent to those soils. Kuma soils have a mollic epipedon that is more than 20 inches thick. Satanta soils contain more sand in the subsoil than the Keith soils. Ulysses soils do not have an argillic horizon.

Typical pedon of Keith silt loam, 0 to 1 percent slopes, about 2,500 feet south and 200 feet west of the northeast corner of sec. 25, T. 11 S., R. 41 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, friable; many fine roots; slightly acid; abrupt smooth boundary.

A2—5 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

Bt1—9 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

Bt2—16 to 24 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few fine roots; neutral; clear smooth boundary.

BC—24 to 34 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—34 to 60 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few accumulations and streaks of lime; strong effervescence; moderately alkaline.

The solum ranges from 16 to 48 inches in thickness. It is silt loam or silty clay loam. The mollic epipedon ranges from 8 to 20 inches in thickness. The depth to lime ranges from 15 to 30 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR, value of 6 to 8 (5 or 6 moist), and chroma of 2 to 4.

Kim Series

The Kim series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in old alluvium. Slope ranges from 5 to 20 percent.

Kim soils commonly are adjacent to Canyon, Colby, and Ulysses soils. Canyon soils are 10 to 20 inches deep over bedrock. They are in the steeper areas. Colby and Ulysses soils have a silty subsoil. They are higher on the landscape than the Kim soils.

Typical pedon of Kim loam, in an area of Kim-Otero complex, 5 to 20 percent slopes, about 1,500 feet west and 300 feet south of the northeast corner of sec. 31, T. 12 S., R. 41 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, very friable; many fine roots; strong effervescence; moderately alkaline; about 1 percent gravel; clear smooth boundary.

AC—6 to 18 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable; many fine roots; strong effervescence; moderately alkaline; about 2 percent gravel; clear wavy boundary.

C1—18 to 52 inches; very pale brown (10YR 7/4) clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; common fine roots; few soft accumulations of lime; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—52 to 60 inches; very pale brown (10YR 8/4) clay loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable; few fine roots; about 5 percent sandstone fragments and gravel; common soft accumulations of lime and common lime concretions; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 18 inches. The texture is loam or clay loam throughout the profile.

The A horizon has hue of 5Y to 7.5YR, value of 5 to 7 (3 to 6 moist), and chroma of 2 to 4. The C horizon has hue of 5Y to 7.5YR, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4.

Kuma Series

The Kuma series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope is 0 to 1 percent.

Kuma soils are similar to Goshen and Keith soils and are commonly adjacent to Keith soils. Goshen soils are in rarely flooded swales. They have no lime to a depth of 35 inches. Keith soils have a mollic epipedon that is less than 20 inches thick. Their positions on the landscape are similar to those of the Kuma soils.

Typical pedon of Kuma silt loam, 0 to 1 percent slopes, 1,900 feet east and 2,000 feet north of the southwest corner of sec. 13, T. 14 S., R. 38 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

Bt1—8 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; many fine roots; neutral; clear smooth boundary.

Bt2—13 to 19 inches; brown (10YR 4/3) silty clay loam, very dark brown (10YR 3/3) moist; strong fine subangular blocky structure; hard, firm; few fine roots; mildly alkaline; gradual smooth boundary.

Btb—19 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong fine subangular blocky structure parting to weak medium granular; hard, firm; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Bkb1—25 to 40 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; few fine roots; common fine accumulations of lime; violent effervescence; moderately alkaline; clear irregular boundary.

Bkb2—40 to 51 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few fine roots; many fine accumulations of lime; violent effervescence; moderately alkaline; diffuse smooth boundary.

C—51 to 60 inches; very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The mollic epipedon ranges from 20 to 48 inches in thickness. The depth to lime ranges from 14 to 35 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It ranges from slightly acid to mildly alkaline. The Bt horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. The Btb horizon also is silt loam or silty clay loam. It has hue of 10YR or 7.5YR, value of 4 to 6 (2 to 4 moist), and chroma is 1 to 3. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Limon Series

The Limon series consists of deep, well drained, slowly permeable soils on terraces. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Limon soils are commonly adjacent to Bridgeport, Midway, and Razor soils. The silty Bridgeport soils are slightly lower on the terraces than the Limon soils. Midway and Razor soils are less than 40 inches deep over shale bedrock. They are on uplands.

Typical pedon of Limon silty clay, 0 to 2 percent slopes, 1,850 feet west and 250 feet south of the northeast corner of sec. 15, T. 13 S., R. 41 W.

A—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak fine subangular blocky structure; very hard, very firm; common fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

By1—4 to 17 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; few shiny films on faces of peds; common streaks of very dark grayish brown material from the A horizon; common fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

By2—17 to 33 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium blocky structure; very hard, very firm; thin faint shiny films on faces of peds; common fine accumulations of gypsum in seams; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Cy—33 to 44 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak medium blocky fragments; very hard, very firm; few fine roots; common accumulations of gypsum in seams; strong effervescence; moderately alkaline; gradual smooth boundary.

Ck—44 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; few fine roots; common thin threads and soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 42 inches. When the soils are dry, cracks 0.5 inch to 2.0 inches wide and several feet long extend downward through the solum.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 moist), and chroma of 2. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It ranges from mildly alkaline to strongly alkaline.

Manter Series

The Manter series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy old alluvium or in eolian material. Slope ranges from 2 to 5 percent.

Manter soils are commonly adjacent to Otero, Satanta, and Ulysses soils. Otero soils do not have a mollic epipedon and have a calcareous surface layer. Satanta and Ulysses soils contain less sand in the subsoil than the Manter subsoils.

Typical pedon of Manter fine sandy loam, 2 to 5 percent slopes, 1,000 feet west and 190 feet north of the southeast corner of sec. 12, T. 14 S., R. 43 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; common fine roots; neutral; clear smooth boundary.

A2—8 to 16 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; common fine roots; neutral; clear smooth boundary.

Bt—16 to 26 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable; few fine roots; neutral; clear smooth boundary.

BC—26 to 36 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable; few accumulations of lime; violent effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 19 inches. The depth to lime ranges from 12 to 40 inches.

The A horizon has hue of 5Y to 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has hue of 5Y to 7.5YR, value of 5 to 7 (3 to 6 moist), and chroma of 2 to 4. The content of gravel in this horizon ranges, by volume, from 0 to 15 percent. The C horizon has hue of 5Y to 7.5YR, value of 5 to 7 (3 to 6 moist), and chroma of 2 to 4.

Midway Series

The Midway series consists of shallow, well drained, slowly permeable soils on uplands. These soils formed in material weathered from calcareous shale. Slope ranges from 5 to 20 percent.

Midway soils are commonly adjacent to Canyon, Colby, Kim, and Razor soils. The loamy Canyon soils are on the steeper slopes above the Midway soils. Colby and Kim soils are more than 40 inches deep over bedrock. They are higher on the landscape than the Midway soils. Razor soils are 20 to 40 inches deep over bedrock. They are in the less sloping areas.

Typical pedon of Midway clay, 5 to 20 percent slopes, 2,400 feet north and 300 feet west of the southeast corner of sec. 1, T. 13 S., R. 41 W.

A—0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium granular structure; very hard, firm; slight effervescence; many fine roots; mildly alkaline; clear smooth boundary.

C—4 to 12 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; very hard, extremely firm; moderately alkaline; strong effervescence; gradual smooth boundary.

Cr—12 inches; light brownish gray (2.5Y 6/2) calcareous clayey shale, grayish brown (2.5Y 5/2) moist.

The depth to shale bedrock is 10 to 20 inches. The A and C horizons have hue of 2.5Y or 10YR, value of 5 or 6 (3 to 5 moist), and chroma of 2 to 4.

Otero Series

The Otero series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in calcareous old alluvium. Slope ranges from 5 to 20 percent.

Otero soils are commonly adjacent to Bankard, Canyon, Kim, and Manter soils. The sandy Bankard soils are on stream terraces. Canyon soils are on side slopes above the Otero soils. They are 10 to 20 inches deep over bedrock. Kim soils contain more clay in the subsoil than the Otero soils. Also, they are higher on the landscape. Manter soils have a mollic epipedon. They are in the less sloping areas.

Typical pedon of Otero sandy loam, in an area of Kim-Otero complex, 5 to 20 percent slopes, 1,500 feet west and 100 feet north of the southeast corner of sec. 30, T. 12 S., R. 41 W.

A—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, very friable; common fine roots; about 5 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

AC—5 to 12 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to weak medium granular; slightly hard, very friable; many fine roots; about 2 percent gravel; strong

effervescence; moderately alkaline; gradual smooth boundary.

C1—12 to 26 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; common fine roots; about 5 percent gravel; violent effervescence; few fine accumulations of lime; moderately alkaline; gradual smooth boundary.

C2—26 to 60 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few fine roots; about 5 to 10 percent gravel; few soft accumulations of lime; violent effervescence; moderately alkaline.

The texture is sandy loam or fine sandy loam throughout the profile. The A horizon has hue of 5Y to 7.5YR, value of 5 to 7 (3 to 6 moist), and chroma of 2 to 4. The C horizon has hue of 5Y to 7.5YR, 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Pleasant Series

The Pleasant series consists of deep, moderately well drained, very slowly permeable soils in small upland depressions. These soils formed in silty or clayey alluvium derived from the adjacent uplands. Slope is 0 to 1 percent.

Pleasant soils commonly are adjacent to Keith and Ulysses soils. The adjacent soils are slightly higher on the landscape than the Pleasant soils. Also, they have a less clayey subsoil.

Typical pedon of Pleasant silty clay loam, about 700 feet south and 500 feet east of the northwest corner of sec. 13, T. 12 S., R. 42 W.

A—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, firm; many fine roots; neutral; clear smooth boundary.

BA—5 to 10 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm; few thin glossy patches on faces of peds; many fine roots; neutral; gradual smooth boundary.

Bt1—10 to 26 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong fine blocky; extremely hard, extremely firm; thin continuous coatings on faces of peds; many fine roots; mildly alkaline; clear wavy boundary.

Bt2—26 to 35 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate fine prismatic structure parting to moderate fine blocky; extremely hard, extremely firm; some darker material from the overlying horizons; common fine roots; mildly alkaline; gradual smooth boundary.

Bt3—35 to 52 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; common fine roots; very hard, very firm; few glossy patches on faces of some peds; mildly alkaline; gradual smooth boundary.

C—52 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, firm; few fine roots; common soft accumulations of lime; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to lime range from 50 to more than 60 inches. The mollic epipedon ranges from 20 to 50 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly silty clay loam, but the range includes silt loam. The Bt horizon has hue of 10YR, value of 4 to 7 (2 to 6 moist), and chroma of 1 to 3. It is silty clay loam, silty clay, or clay. The C horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 5. Some pedons have dark buried horizons below a depth of 40 inches.

Razor Series

The Razor series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in calcareous shale residuum. Slope ranges from 1 to 6 percent.

Razor soils are commonly adjacent to Midway and Colby soils. Midway soils are 10 to 20 inches deep over bedrock. They are on the steeper side slopes. The silty Colby soils are more than 40 inches deep over bedrock. They are on side slopes above the Razor soils.

Typical pedon of Razor clay, 1 to 6 percent slopes, 1,700 feet south and 800 feet east of the northwest corner of sec. 19, T. 12 S., R. 40 W.

A—0 to 6 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; extremely hard, firm; common fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

BA—6 to 16 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine blocky structure; extremely hard, very firm; common fine roots; strong effervescence; mildly alkaline; clear smooth boundary.

Bw—16 to 24 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate medium blocky structure; extremely hard, extremely firm; few fine roots; common soft accumulations of lime in seams and few calcite crystals; violent effervescence; moderately alkaline; clear smooth boundary.

C—24 to 32 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky fragments; extremely hard, very firm; few fine roots; few gypsum concretions and few soft accumulations of lime; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—32 inches; light olive gray (5Y 6/2) clayey shale, olive (5Y 4/3) moist; thin seams of calcite crystals.

The thickness of the solum ranges from 20 to 36 inches. The depth to bedrock ranges from 20 to 40 inches. The texture is clay or silty clay above the bedrock.

The A horizon has hue of 5Y to 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It ranges from neutral to moderately alkaline. The Bw horizon has hue of 5Y to 10YR, value 4 to 6 (4 or 5 moist), and chroma of 2 to 4. It is mildly alkaline or moderately alkaline. The C horizon also is mildly alkaline or moderately alkaline. It has hue of 5Y to 10YR, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4.

Satanta Series

The Satanta series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy eolian material or in loamy old alluvium. Slope ranges from 1 to 3 percent.

Satanta soils are similar to Keith soils and are commonly adjacent to Keith, Manter, and Ulysses soils. Keith and Ulysses soils have a silty subsoil. Keith soils are in nearly level areas on uplands. Ulysses soils are on the smoother, more sloping parts of the landscape. Manter soils contain less clay in the subsoil than the Satanta soils. They are on the more rolling slopes.

Typical pedon of Satanta loam, 1 to 3 percent slopes, 2,400 feet north and 100 feet east of the southwest corner of sec. 7, T. 14 S., R. 42 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

A—6 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; few worm casts; gradual smooth boundary.

Bt—12 to 22 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine subangular blocky structure; slightly hard, friable; thin clay films on faces of peds; few worm casts; mildly alkaline; gradual smooth boundary.

BC—22 to 34 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak fine subangular blocky structure; slightly hard, friable; threads and films of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—34 to 60 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive, porous; slightly hard, friable; threads of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The depth to lime ranges from 15 to 36 inches. The mollic epipedon is 8 to 20 inches thick.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly loam, but the range includes very fine sandy loam, clay loam, and fine sandy loam. This horizon ranges from slightly acid to mildly alkaline. The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is clay loam, loam, or sandy clay loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is clay loam, sandy clay loam, or very fine sandy loam. It is mildly alkaline or moderately alkaline.

Sweetwater Series

The Sweetwater series consists of deep, poorly drained soils on flood plains. These soils formed in loamy sediments that are 10 to 30 inches deep over sandy alluvium. Permeability is moderately slow in the solum and rapid in the substratum. Slope is 0 to 1 percent.

These soils formed in a slightly colder climate than is definitive for the Sweetwater series. This difference, however, does not significantly affect the usefulness or behavior of the soils.

Sweetwater soils are commonly adjacent to Bankard, Bridgeport, and Caruso soils. The somewhat excessively drained Bankard soils are on the slightly higher flood plains. They have a sandy subsoil. The well drained Bridgeport soils are on the slightly higher stream terraces. They have a silty subsoil. The somewhat poorly drained Caruso soils are on the slightly higher flood plains. Their substratum is loamy throughout.

Typical pedon of Sweetwater clay loam, occasionally flooded, 2,500 feet west and 800 feet south of the northeast corner of sec. 11, T. 11 S., R. 38 W.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; common fine and coarse roots; slight effervescence; moderately alkaline; clear smooth boundary.

A2—10 to 14 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; few medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium granular structure; very hard, firm; common fine and medium roots; strong effervescence; moderately alkaline; clear smooth boundary.

C1—14 to 24 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium granular structure; very hard, firm; many fine roots; threads and accumulations of lime; violent effervescence; moderately alkaline; abrupt smooth boundary.

2C2—24 to 42 inches; very pale brown (10YR 7/3) loamy fine sand, brown (10YR 4/3) moist; few coarse distinct dark yellowish brown (10YR 4/4) mottles; single grained; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

2C3—42 to 60 inches; very pale brown (10YR 7/3) sand, brown (10YR 4/3) moist; common fine faint dark brown (7.5YR 4/4) mottles; single grained; loose; very few fine roots; violent effervescence; moderately alkaline.

The mollic epipedon is 10 to 19 inches thick. The depth to the sandy 2C horizon ranges from 10 to 30 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 0 to 2. It is dominantly clay loam, but the range includes loam and silty clay loam. The C and 2C horizons have hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 1 to 3.

Ulysses Series

The Ulysses series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 6 percent.

Ulysses soils are similar to Colby and Keith soils and are commonly adjacent to Colby, Keith, and Kim soils. Colby and Kim soils do not have a mollic epipedon. They are on the steeper slopes, generally below the Ulysses soils. Keith soils have an argillic horizon. They are on broad upland flats.

Typical pedon of Ulysses silt loam, 1 to 3 percent slopes, about 200 feet east and 100 feet south of the northwest corner of sec. 26, T. 13 S., R. 41 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

A2—4 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

Bw—10 to 19 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—19 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few fine roots; few fine threads and soft accumulations of lime; strong effervescence; moderately alkaline.

The solum ranges from 10 to 24 inches in thickness. It is silt loam, loam, or silty clay loam. The depth to lime ranges from 7 to 15 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The Bw horizon has hue of 10YR, value 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3.

Formation of the Soils

The characteristics of a soil at any given place are determined by the interactions among five factors of soil formation—climate, plants and other living organisms, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Climate and vegetation act on the parent material and gradually change it to a natural body of soil. Relief modifies the effects of climate and vegetation, mainly through its effect on runoff and temperature. The nature of the parent material affects the kind of soil that forms. Time is needed for changing the parent material into a soil. Generally, a long period is needed for the formation of distinct horizons.

Parent Material

Parent material is the unconsolidated material in which a soil forms. It mainly determines the chemical and mineralogical composition of the soil and the rate of soil formation. The parent materials of the soils in Wallace County are loess; old alluvium of the Ogallala Formation, or Pleistocene epoch; recent alluvium; and bedrock residuum.

Soils that formed in loess are the most extensive soils in the county. These are the Colby, Keith, Kuma, and Ulysses soils. The loess is silty, wind-deposited material. It is many feet thick throughout much of the county.

Old and recent alluvium is sediment that has been transported by water. The old alluvial sediment is on uplands. Kim and Otero soils formed in this material. The recent alluvial sediment is on flood plains and stream terraces. Bankard, Bridgeport, Caruso, Glenberg, Goshen, and Sweetwater soils formed in recent alluvium.

The bedrock that crops out in Wallace County is mainly lime-cemented sandstone or caliche and clayey shale. The lime-cemented sandstone or caliche is from the Ogallala Formation of the Tertiary System. Canyon soils formed in material weathered from this bedrock. Midway and Razor soils formed in clayey material weathered from Pierre Shale, of the Cretaceous System. Bedrock from the Smoky Hill Chalk Member, also in the Cretaceous System, is in a small area in the eastern part of the county. Elkader soils formed in colluvium weathered from this chalky material.

Climate

Climate is an active factor of soil formation. It directly affects the soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plants and animals.

The climate of Wallace County is typical continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. The accumulation of soft lime in the substratum of Kuma soils is an indication of this excess moisture. Because of the downward movement of water, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils.

Plant and Animal Life

Plant and animal life is an important factor of soil formation. Plants generally affect the content of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous. Earthworms in some soils have left many worm casts. Bacteria and fungi help to decompose plants, thus releasing more plant nutrients.

The mid and tall prairie grasses have had the greatest effect on soil formation in Wallace County. As a result of the grasses, the upper part of a typical soil in the county is dark and has a high content of organic matter. The next part in many places is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color and high in content of carbonates.

Relief

Relief affects the formation of soils through its effects on drainage, runoff, plant cover, and soil temperature. The temperature of the soil, for example, is slightly lower on the east- and north-facing slopes than on west- and south-facing slopes. Although climate and plants are the most active factors in the formation of soils, relief also is

important, mainly because it controls the movement of water on the surface and into the soil.

On the sloping or steep soils in the uplands, the runoff rate is higher than that in the less sloping areas. As a result, erosion is more extensive. Relief has retarded the formation of Canyon soils, which formed in some of the oldest parent material in the county. Runoff is rapid on these moderately sloping to steep soils; and, therefore, much of the soil material is removed as soon as the soil forms.

Runoff is slow on the nearly level Keith soils. Most of the precipitation that falls on these soils penetrates the surface. As a result of this, the soils have well defined horizons.

Time

As water moves through the soil, soluble matter and fine particles gradually are leached from the surface layer to the subsoil. The amount of leaching depends on the amount of time that has elapsed and the amount of water that penetrates the surface. Differences in the length of time that the parent material has been exposed to the processes of soil formation are reflected in the degree of profile development. For example, the young Bankard soils, which formed in recent alluvium, show very little evidence of horizon development. In contrast, the older Keith soils, which have been exposed to soil-forming processes for thousands of years, have well defined horizons.

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Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series

because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-76 at Sharon Springs, Kansas)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average daily	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	47.4	16.3	31.9	73	-11	0.40	0.08	0.72	1	4.6
February---	51.5	20.2	35.9	78	- 5	.43	.08	.57	1	4.9
March------	57.4	25.4	41.4	85	- 1	1.17	.46	1.79	3	7.6
April------	69.3	36.5	52.9	90	15	1.27	.56	1.90	3	1.7
May--------	79.1	47.5	63.3	99	29	2.90	1.53	3.92	6	.2
June-------	89.8	57.3	73.6	108	40	3.17	1.19	5.47	6	.0
July-------	94.9	63.1	79.0	108	51	2.84	1.17	4.36	5	.0
August-----	93.1	61.0	77.1	106	46	1.85	.85	2.80	4	.0
September--	83.8	50.8	67.3	102	31	1.68	.44	2.70	3	.0
October----	73.3	38.9	56.1	94	22	1.04	.30	1.98	2	1.0
November---	57.0	26.1	41.6	79	0	.75	.11	1.27	2	2.9
December---	48.0	19.0	33.5	75	- 9	.45	.08	.72	1	5.6
Year-----	70.4	38.5	54.5	108	-15	17.95	13.62	21.89	37	28.5

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 24	May 7	May 20
2 years in 10 later than--	April 19	May 2	May 15
5 years in 10 later than--	April 10	April 22	May 5
First freezing temperature in fall:			
1 year in 10 earlier than--	October 14	October 4	September 23
2 years in 10 earlier than--	October 18	October 9	September 27
5 years in 10 earlier than--	October 28	October 18	October 7

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	179	158	134
8 years in 10	187	165	141
5 years in 10	201	179	155
2 years in 10	215	193	169
1 year in 10	223	200	176

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bb	Bankard loamy sand, occasionally flooded	6,740	1.2
Bc	Bankard sandy loam	5,330	0.9
Bo	Bridgeport loam, occasionally flooded	6,750	1.2
Bp	Bridgeport silt loam, 0 to 2 percent slopes	22,300	3.8
Br	Bridgeport silt loam, 2 to 6 percent slopes	2,800	0.5
Bs	Bridgeport-Arvada complex	3,080	0.5
Cd	Canyon loam, 5 to 30 percent slopes	7,450	1.3
Ch	Caruso loam, occasionally flooded	5,830	1.0
Co	Colby silt loam, 3 to 6 percent slopes	49,000	8.4
Cp	Colby silt loam, 6 to 15 percent slopes	34,000	5.8
Ec	Elkader silt loam, 2 to 6 percent slopes	1,160	0.2
Gb	Glenberg sandy loam	1,050	0.2
Go	Goshen silt loam	12,500	2.1
Ke	Keith silt loam, 0 to 1 percent slopes	72,000	12.3
Ko	Kim-Otero complex, 5 to 20 percent slopes	27,500	4.7
Ku	Kuma silt loam, 0 to 1 percent slopes	12,300	2.1
Lm	Limon silty clay, 0 to 2 percent slopes	758	0.1
Mc	Manter fine sandy loam, 2 to 5 percent slopes	2,750	0.5
Mh	Midway clay, 5 to 20 percent slopes	11,130	1.9
Po	Pleasant silty clay loam	2,050	0.4
Rc	Razor clay, 1 to 6 percent slopes	1,630	0.3
Sc	Satanta loam, 1 to 3 percent slopes	2,730	0.5
Se	Sweetwater clay loam, occasionally flooded	5,360	0.9
Ua	Ulysses silt loam, 0 to 1 percent slopes	53,000	9.1
Ub	Ulysses silt loam, 1 to 3 percent slopes	172,500	29.3
Uc	Ulysses silt loam, 3 to 6 percent slopes	58,000	9.9
Us	Ulysses-Colby complex, 1 to 4 percent slopes	5,000	0.9
	Total	584,698	100.0

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Corn		Winter wheat		Grain sorghum	
	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu
Bb----------------------- Bankard	VIw	---	---	---	---	---	---	---
Bc----------------------- Bankard	VIs	IVs	---	75	---	---	---	60
Bo----------------------- Bridgeport	IIIw	IIw	---	115	24	40	43	110
Bp----------------------- Bridgeport	IIIc	I	---	145	32	55	45	135
Br----------------------- Bridgeport	IIIe	IIIe	---	110	28	42	39	105
Bs----------------------- Bridgeport-Arvada	VIs	IVs	---	80	---	30	---	75
Cd----------------------- Canyon	VIs	---	---	---	---	---	---	---
Ch----------------------- Caruso	IIIw	IIw	45	110	22	35	37	105
Co----------------------- Colby	IVe	IVe	---	90	24	35	31	85
Cp----------------------- Colby	VIe	---	---	---	---	---	---	---
Ec----------------------- Elkader	IVe	IIIe	---	95	24	40	31	85
Gb----------------------- Glenberg	IIIe	IIe	---	90	18	35	21	80
Go----------------------- Goshen	IIIc	I	---	150	32	55	49	120
Ke----------------------- Keith	IIIc	I	---	150	34	60	47	120
Ko----------------------- Kim-Otero	VIe	---	---	---	---	---	---	---
Ku----------------------- Kuma	IIIc	I	---	150	35	60	47	120
Lm----------------------- Limon	IVs	IIIs	---	80	20	35	26	60
Mc----------------------- Manter	IVe	IIIe	---	95	20	40	26	80
Mh----------------------- Midway	VIe	---	---	---	---	---	---	---
Po----------------------- Pleasant	IVw	IVw	---	75	25	35	35	90
Rc----------------------- Razor	IVe	IVe	---	65	18	30	25	50
Sc----------------------- Satanta	IIIe	IIe	---	130	29	50	40	120

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Winter wheat		Grain sorghum	
	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu
Se------------------------- Sweetwater	Vw	---	---	---	---	---	---	---
Ua------------------------- Ulysses	IIIc	I	---	145	32	55	45	135
Ub------------------------- Ulysses	IIIe	IIe	---	130	29	50	40	120
Uc------------------------- Ulysses	IVe	IIIe	---	100	26	45	36	100
Us------------------------- Ulysses-Colby	IIIe	IIe	---	123	28	48	37	115

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bb: Bankard	Sands	Favorable	3,000	Sand bluestem	30
		Normal	2,000	Prairie sandreed	20
		Unfavorable	1,500	Western wheatgrass	15
				Sand dropseed	10
				Needleandthread	10
				Indian ricegrass	5
Bc: Bankard	Sandy	Favorable	2,600	Sand bluestem	30
		Normal	1,800	Needleandthread	15
		Unfavorable	1,000	Prairie sandreed	15
				Blue grama	10
				Western wheatgrass	5
				Sand dropseed	5
				Sand sage	5
Bo: Bridgeport	Loamy Lowland	Favorable	4,000	Big bluestem	35
		Normal	3,000	Sideoats grama	25
		Unfavorable	2,000	Western wheatgrass	15
				Little bluestem	10
Bp, Br: Bridgeport	Loamy Terrace	Favorable	4,000	Big bluestem	35
		Normal	3,000	Sideoats grama	25
		Unfavorable	2,000	Western wheatgrass	15
				Little bluestem	10
Bs*:					
Bridgeport	Loamy Terrace	Favorable	4,000	Big bluestem	35
		Normal	3,000	Sideoats grama	25
		Unfavorable	2,000	Western wheatgrass	15
				Little bluestem	10
Arvada	Saline Lowland	Favorable	1,500	Western wheatgrass	30
		Normal	1,000	Blue grama	20
		Unfavorable	800	Inland saltgrass	20
				Fourwing saltbush	10
				Switchgrass	10
				Bottlebrush squirreltail	5
Cd: Canyon	Shallow Limy	Favorable	1,500	Little bluestem	30
		Normal	1,300	Sideoats grama	20
		Unfavorable	700	Blue grama	10
				Big bluestem	10
				Needleandthread	5
				Hairy grama	5
				Western wheatgrass	5
				Plains muhly	5
Ch: Caruso	Subirrigated	Favorable	7,500	Big bluestem	30
		Normal	6,500	Switchgrass	15
		Unfavorable	5,000	Prairie cordgrass	10
				Indiangrass	10
				Western wheatgrass	5
				Sedge	5
Co, Cp: Colby	Limy Upland	Favorable	2,400	Little bluestem	20
		Normal	1,400	Blue grama	15
		Unfavorable	800	Sideoats grama	15
				Western wheatgrass	10
				Big bluestem	10
				Buffalograss	5
				Tall dropseed	5
				Small soapweed	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
Ec-- Elkader	Limy Upland	Favorable	2,400	Little bluestem	20
		Normal	1,400	Blue grama	15
		Unfavorable	1,000	Big bluestem	15
				Sideoats grama	10
				Western wheatgrass	10
				Tall dropseed	5
				Small soapweed	5
Gb-- Glenberg	Sandy Terrace	Favorable	3,000	Prairie sandreed	20
		Normal	2,500	Switchgrass	15
		Unfavorable	2,000	Sand bluestem	15
				Needlegrass	10
				Blue grama	5
				Sand dropseed	5
				Little bluestem	5
				Sideoats grama	5
				Sand sagebrush	5
				Sedge	5
Go-- Goshen	Loamy Terrace	Favorable	3,000	Big bluestem	30
		Normal	2,400	Sideoats grama	15
		Unfavorable	1,500	Little bluestem	15
				Switchgrass	10
				Blue grama	5
				Sand lovegrass	5
Ke-- Keith	Loamy Upland	Favorable	2,500	Blue grama	25
		Normal	2,000	Western wheatgrass	20
		Unfavorable	1,500	Needleandthread	10
				Buffalograss	10
				Sedge	10
				Little bluestem	5
Ko*:					
Kim	Limy Upland	Favorable	2,400	Little bluestem	25
		Normal	1,400	Big bluestem	15
		Unfavorable	1,000	Sideoats grama	15
				Blue grama	10
				Western wheatgrass	10
				Green needlegrass	5
Otero	Sandy	Favorable	1,800	Blue grama	30
		Normal	1,500	Prairie sandreed	20
		Unfavorable	1,000	Needlegrass	15
				Sideoats grama	10
				Little bluestem	5
				Sand dropseed	5
				Sand sagebrush	5
Ku-- Kuma	Loamy Upland	Favorable	2,000	Blue grama	60
		Normal	1,500	Buffalograss	10
		Unfavorable	800	Western wheatgrass	10
				Needlegrass	5
Lm-- Limon	Clay Terrace	Favorable	3,000	Western wheatgrass	50
		Normal	2,000	Fourwing saltbush	10
		Unfavorable	1,000	Green needlegrass	10
				Indian ricegrass	10
				Blue grama	5
				Alkali sacaton	5
Mc-- Manter	Sandy	Favorable	2,500	Blue grama	20
		Normal	1,800	Prairie sandreed	15
		Unfavorable	1,400	Sideoats grama	15
				Little bluestem	10
				Switchgrass	10
				Sand dropseed	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Mh: Midway	Shale Breaks	Favorable	1,600	Western wheatgrass	30
		Normal	1,400	Sideoats grama	15
		Unfavorable	950	Green needlegrass	15
				Blue grama	10
				Buffalograss	5
				Prairie junegrass	5
				Little bluestem	5
Po: Pleasant	Clay Upland	Favorable	2,400	Western wheatgrass	50
		Normal	1,800	Buffalograss	15
		Unfavorable	1,000	Blue grama	10
				Sedge	5
Rc: Razor	Clay Upland	Favorable	1,500	Western wheatgrass	30
		Normal	1,000	Alkali sacaton	20
		Unfavorable	700	Blue grama	20
				Inland saltgrass	5
				Bottlebrush squirreltail	5
Sc: Satanta	Loamy Upland	Favorable	2,300	Prairie sandreed	25
		Normal	1,500	Blue grama	20
		Unfavorable	1,200	Needleandthread	20
				Little bluestem	15
				Western wheatgrass	15
				Big bluestem	10
				Sand dropseed	5
Se: Sweetwater	Subirrigated	Favorable	5,000	Big bluestem	30
		Normal	4,250	Switchgrass	15
		Unfavorable	3,500	Indiangrass	10
				Western wheatgrass	5
				Sedge	5
				Prairie cordgrass	5
				Eastern gamagrass	5
				Alkali sacaton	5
Ua, Ub, Uc: Ulysses	Loamy Upland	Favorable	2,400	Blue grama	25
		Normal	1,800	Western wheatgrass	20
		Unfavorable	1,000	Sideoats grama	20
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10
				Small soapweed	5
Us*:					
Ulysses	Loamy Upland	Favorable	2,400	Blue grama	25
		Normal	1,800	Western wheatgrass	15
		Unfavorable	1,000	Sideoats grama	10
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10
				Small soapweed	5
Colby	Limy Upland	Favorable	1,600	Little bluestem	20
		Normal	1,200	Blue grama	15
		Unfavorable	800	Sideoats grama	15
				Western wheatgrass	10
				Big bluestem	10
				Buffalograss	5
				Tall dropseed	5
				Small soapweed	5
				Needleandthread	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Bb---------------- Bankard	American plum, skunkbush sumac.	Siberian peashrub, Russian-olive, hackberry.	Eastern redcedar, honeylocust, green ash, ponderosa pine.	Siberian elm------	---
Bc---------------- Bankard	Siberian elm, lilac, American plum.	Amur honeysuckle	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, hackberry, green ash, Russian-olive.	Honeylocust-------	Eastern cottonwood.
Bo, Bp, Br--------- Bridgeport	Lilac, American plum.	Amur honeysuckle	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, hackberry, green ash, Russian-olive.	Honeylocust, Siberian elm.	Eastern cottonwood.
Bs*: Bridgeport--------	Lilac, American plum.	Amur honeysuckle	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, hackberry, green ash, Russian-olive.	Honeylocust, Siberian elm.	Eastern cottonwood.
Arvada.					
Cd. Canyon					
Ch---------------- Caruso	American plum, lilac.	Amur honeysuckle	Russian-olive, eastern redcedar, Rocky Mountain juniper, green ash, ponderosa pine, hackberry.	Honeylocust, golden willow.	Siberian elm, eastern cottonwood.
Co, Cp------------ Colby	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, ponderosa pine, Rocky Mountain juniper, green ash, black locust.	Siberian elm, honeylocust.	---	---
Ec---------------- Elkader	Siberian peashrub, fragrant sumac, Tatarian honeysuckle, silver buffaloberry.	Eastern redcedar, ponderosa pine, Rocky Mountain juniper, green ash, black locust, Russian-olive.	Honeylocust, Siberian elm.	---	---
Gb---------------- Glenberg	Lilac, American plum.	Amur honeysuckle	Hackberry, green ash, Russian-olive.	Siberian elm------	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Go----------------- Goshen	Lilac, American plum.	Amur honeysuckle	Eastern redcedar, green ash, Rocky Mountain juniper, hackberry, ponderosa pine, Russian-olive.	Honeylocust, Siberian elm.	Eastern cottonwood.
Ke----------------- Keith	Lilac, American plum.	Rocky Mountain juniper, common chokecherry, Siberian peashrub.	Hackberry, ponderosa pine, honeylocust, Russian-olive.	Siberian elm------	---
Ko*:					
Kim---------------	Siberian peashrub, Amur honeysuckle.	Russian-olive, Rocky Mountain juniper, ponderosa pine.	Honeylocust, Siberian elm.	---	---
Otero-------------	Lilac, American plum, common chokecherry, Amur honeysuckle.	Russian mulberry	Hackberry, green ash.	Siberian elm------	---
Ku----------------- Kuma	American plum, lilac, skunkbush sumac.	Rocky Mountain juniper, Russian-olive, Siberian peashrub, hackberry.	Ponderosa pine, honeylocust, green ash, eastern redcedar.	Siberian elm------	---
Lm----------------- Limon	Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper.	Siberian elm------	---	---
Mc----------------- Manter	Common chokecherry, lilac, Amur honeysuckle, American plum.	Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, ponderosa pine, skunkbush sumac, hackberry, green ash.	Siberian elm------	---
Mh. Midway					
Po. Pleasant					
Rc----------------- Razor	Siberian peashrub, lilac, silver buffaloberry, American plum.	Green ash, Russian-olive, Siberian crabapple, common chokecherry, Rocky Mountain juniper.	Siberian elm, ponderosa pine.	---	---
Sc----------------- Satanta	Fragrant sumac, lilac, Amur honeysuckle.	Russian-olive, common chokecherry.	Eastern redcedar, honeylocust, ponderosa pine, green ash, hackberry, bur oak.	Siberian elm------	---
Se----------------- Sweetwater	Silver buffaloberry, Tatarian honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, Rocky Mountain juniper, green ash, Russian-olive.	Golden willow, Siberian elm.	---	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ua, Ub, Uc Ulysses	Fragrant sumac, Amur honeysuckle, lilac.	Russian-olive, common chokecherry.	Eastern redcedar, honeylocust, ponderosa pine, green ash, bur oak.	Siberian elm	---
Us*:					
Ulysses	Fragrant sumac, Amur honeysuckle, lilac.	Russian-olive, common chokecherry.	Eastern redcedar, honeylocust, ponderosa pine, green ash, bur oak.	Siberian elm	---
Colby	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, ponderosa pine, Rocky Mountain juniper, green ash, black locust.	Siberian elm, honeylocust.	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bb-------------------- Bankard	Severe: flooding.	Slight---------------	Moderate: flooding.	Slight.
Bc-------------------- Bankard	Severe: flooding.	Slight---------------	Moderate: small stones.	Slight.
Bo-------------------- Bridgeport	Severe: flooding.	Slight---------------	Moderate: flooding.	Slight.
Bp-------------------- Bridgeport	Severe: flooding.	Slight---------------	Slight---------------	Slight.
Br-------------------- Bridgeport	Slight---------------	Slight---------------	Moderate: slope.	Slight.
Bs*:				
Bridgeport-----------	Severe: flooding.	Slight---------------	Slight---------------	Slight.
Arvada---------------	Severe: flooding, excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight.
Cd-------------------- Canyon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Moderate: slope, dusty.
Ch-------------------- Caruso	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.
Co-------------------- Colby	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.
Cp-------------------- Colby	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Ec-------------------- Elkader	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Gb-------------------- Glenberg	Severe: flooding.	Slight---------------	Moderate: small stones.	Slight.
Go-------------------- Goshen	Severe: flooding.	Slight---------------	Slight---------------	Slight.
Ke-------------------- Keith	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Ko*:				
Kim------------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Otero----------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ku-------------------- Kuma	Slight---------------	Slight---------------	Slight---------------	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Lm: Limon	Severe: flooding.	Moderate: excess salt.	Moderate: excess salt.	Slight.
Mc: Manter	Slight	Slight	Moderate: slope, small stones.	Slight.
Mh: Midway	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Slight.
Po: Pleasant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rc: Razor	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
Sc: Satanta	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Se: Sweetwater	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Ua: Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Ub, Uc: Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Us*:				
Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Colby	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor")

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Bb, Bc------------- Bankard	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Bo, Bp------------- Bridgeport	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Poor.
Br----------------- Bridgeport	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Poor.
Bs*:									
Bridgeport---------	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Poor.
Arvada-------------	Very poor	Very poor	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor.
Cd----------------- Canyon	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Ch----------------- Caruso	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair.
Co----------------- Colby	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Cp----------------- Colby	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Ec----------------- Elkader	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Poor.
Gb----------------- Glenberg	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Go----------------- Goshen	Fair	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Ke----------------- Keith	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Ko*:									
Kim----------------	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
Otero--------------	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Fair.
Ku----------------- Kuma	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Lm----------------- Limon	Poor	Poor	Fair	Poor	Poor	Very poor	Poor	Very poor	Fair.
Mc----------------- Manter	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Mh----------------- Midway	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Po----------------- Pleasant	Poor	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Rc----------------- Razor	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Sc------------------ Satanta	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Se------------------ Sweetwater	Very poor	Poor	Good	Fair	Good	Good	Poor	Good	Fair.
Ua, Ub, Uc---------- Ulysses	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Us*:									
Ulysses------------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Colby--------------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Bb: Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Bc: Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Bo: Bridgeport	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Bp: Bridgeport	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Br: Bridgeport	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Bs*:					
Bridgeport	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Arvada	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Cd: Canyon	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Ch: Caruso	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.
Co: Colby	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Cp: Colby	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Ec: Elkader	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Gb: Glenberg	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Go: Goshen	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ke: Keith	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Ko*:					
Kim	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Otero	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Ku: Kuma	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Lm: Limon	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and	Shallow	Dwellings basements	Dwellings basements	Small buildings	Local roads
Mc----------------- Manter	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
Mh----------------- Midway	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
Po----------------- Pleasant	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
Rc----------------- Razor	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Sc----------------- Satanta	Slight-----------	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
Se----------------- Sweetwater	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.
Ua, Ub------------ Ulysses	Slight-----------	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell.	Severe: low strength.
Uc----------------- Ulysses	Slight-----------	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell, slope.	Severe: low strength.
Us*:					
Ulysses-----------	Slight-----------	Moderate: shrink-swell.	Slight-----------	Moderate: shrink-swell.	Severe: low strength.
Colby-------------	Slight-----------	Slight-----------	Slight-----------	Slight------------	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bb: Bankard	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
Bc: Bankard	Severe: poor filter.	Severe: seepage, flooding.	Severe: too sandy.	Moderate: flooding.	Poor: too sandy.
Bo: Bridgeport	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Bp: Bridgeport	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Br: Bridgeport	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Bs*:					
Bridgeport	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Arvada	Severe: percs slowly.	Severe: flooding.	Severe: excess salt.	Moderate: flooding.	Good.
Cd: Canyon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Ch: Caruso	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
Co: Colby	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Cp: Colby	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Ec: Elkader	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Gb: Glenberg	Moderate: flooding.	Severe: seepage, flooding.	Moderate: flooding, too sandy.	Moderate: flooding.	Fair: too sandy.
Go: Goshen	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Ke: Keith	Slight	Moderate: seepage.	Slight	Slight	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption	Sewage lagoon areas	Trench sanitary	Area sanitary	Daily cover for landfill
Ko*:					
Kim	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
Otero	Moderate: slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: small stones, slope.
Ku Kuma	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Lm Limon	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: hard to pack.
Mc Manter	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Mh Midway	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
Po Pleasant	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Rc Razor	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, excess salt.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
Sc Satanta	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Se Sweetwater	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy, wetness.
Ua Ulysses	Slight	Moderate: seepage.	Slight	Slight	Good.
Ub, Uc Ulysses	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Us*:					
Ulysses	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Colby	Slight	Moderate: seepage, slope.	Slight	Slight	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bb: Bankard	Good	Probable	Improbable: too sandy.	Poor: area reclaim.
Bc: Bankard	Good	Probable	Improbable: excess fines.	Poor: small stones.
Bo, Bp, Br: Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Bs*:				
Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Arvada	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
Cd: Canyon	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Ch: Caruso	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Co: Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cp: Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Ec: Elkader	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Gb: Glenberg	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Go: Goshen	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ke: Keith	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ko*:				
Kim	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Otero	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ku: Kuma	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lm: Limon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: excess salt.
Mc: Manter	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Mh: Midway	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
Po: Pleasant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Rc: Razor	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Sc: Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Se: Sweetwater	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Ua, Ub, Uc: Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Us*:				
Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bb: Bankard	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
Bc: Bankard	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Bo: Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
Bp: Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Br: Bridgeport	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Bs*:						
Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Arvada	Moderate: seepage.	Severe: excess sodium, excess salt.	Deep to water	Droughty, percs slowly.	Erodes easily	Excess salt, excess sodium, erodes easily.
Cd: Canyon	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Ch: Caruso	Moderate: seepage.	Severe: piping.	Flooding	Wetness, flooding.	Wetness	Favorable.
Co: Colby	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Cp: Colby	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ec: Elkader	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Gb: Glenberg	Severe: seepage.	Severe: piping.	Deep to water	Droughty	Too sandy, soil blowing.	Droughty.
Go: Goshen	Moderate: seepage.	Severe: thin layer.	Deep to water	Favorable	Erodes easily	Erodes easily.
Ke: Keith	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Ko*:						
Kim	Severe: slope.	Severe: piping.	Deep to water	Slope, excess salt.	Slope	Slope.
Otero	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, soil blowing.	Slope, soil blowing.	Slope, droughty.
Ku: Kuma	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Lm----------------- Limon	Slight----------	Moderate: hard to pack.	Deep to water	Percs slowly---	Percs slowly---	Excess salt, percs slowly.
Mc----------------- Manter	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing---	Too sandy, soil blowing.	Favorable.
Mh----------------- Midway	Severe: depth to rock, slope.	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Po----------------- Pleasant	Moderate: seepage.	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Rc----------------- Razor	Moderate: depth to rock, slope.	Severe: excess salt.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Sc----------------- Satanta	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
Se----------------- Sweetwater	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Wetness.
Ua, Ub------------- Ulysses	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Uc----------------- Ulysses	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
Us*:						
Ulysses-----------	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Colby-------------	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Bb------------------ Bankard	0-5	Loamy sand--------	SM	A-2	0	95-100	90-100	50-90	15-35	---	NP
	5-60	Stratified loamy fine sand to gravelly coarse sand.	SP, SP-SM, SM	A-2, A-3, A-1	0	90-100	50-100	20-75	0-20	---	NP
Bc------------------ Bankard	0-5	Sandy loam--------	SM, SM-SC	A-2, A-4	0	100	90-100	50-70	30-40	15-25	NP-10
	5-60	Stratified fine sand to loam.	SM, SP-SM	A-2, A-3	0-5	80-100	75-95	40-75	5-35	---	NP
Bo------------------ Bridgeport	0-16	Loam--------------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	4-19
	16-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	90-100	65-100	25-40	8-20
Bp, Br------------- Bridgeport	0-12	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	4-19
	12-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	90-100	65-100	25-40	8-20
Bs*:											
Bridgeport-------	0-6	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	4-19
	6-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	90-100	65-100	25-40	8-20
Arvada-----------	0-2	Loam--------------	CL-ML, CL	A-4, A-6	0	80-100	75-100	70-100	50-85	20-30	5-15
	2-22	Clay, clay loam, silty clay loam.	CH, CL	A-7, A-6	0	95-100	75-100	75-100	60-95	35-60	15-40
	22-60	Loam, clay loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	75-100	75-100	65-95	50-85	20-30	5-15
Cd------------------ Canyon	0-4	Loam--------------	ML, CL, CL-ML	A-4	0-5	90-95	75-95	50-95	50-75	15-30	2-10
	4-14	Very fine sandy loam, loam, gravelly loam.	ML, SM, SC, GM	A-4	0-5	60-95	50-95	45-95	35-75	<20	NP-10
	14	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ch------------------ Caruso	0-16	Loam--------------	CL, CL-ML	A-4, A-6	0	100	100	95-100	65-90	25-40	5-20
	16-60	Loam, clay loam, silt loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	65-85	25-45	5-20
Co, Cp------------- Colby	0-5	Silt loam---------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	5-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Ec------------------ Elkader	0-10	Silt loam---------	ML, CL	A-4, A-6, A-7-6	0	95-100	85-100	80-100	65-90	25-45	7-20
	10-18	Silt loam, silty clay loam, clay loam.	CL, ML	A-4, A-6, A-7-6	0	95-100	85-100	80-100	70-95	25-50	7-20
	18-60	Silt loam, silty clay loam, clay loam.	CL, ML	A-4, A-6, A-7-6	0	95-100	85-100	80-100	70-95	25-50	7-20
Gb------------------ Glenberg	0-30	Sandy loam--------	SM	A-4, A-2	0	95-100	85-100	60-100	30-45	---	NP
	30-60	Stratified loamy sand to clay loam.	SM	A-2, A-4	0	90-100	75-100	50-100	25-40	---	NP
Go------------------ Goshen	0-16	Silt loam---------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	90-100	70-95	20-40	3-20
	16-39	Silty clay loam, loam, silt loam.	CL	A-6, A-4	0	100	100	90-100	65-95	25-40	8-22
	39-60	Silt loam, loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	20-35	4-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ke----------------- Keith	0-9	Silt loam----------	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
	9-24	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-25
	24-60	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-35	2-12
Ko*:											
Kim---------------	0-6	Loam---------------	ML, CL-ML	A-4	0-5	80-100	75-100	60-90	55-75	20-30	NP-10
	6-60	Loam, clay loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	80-100	75-100	50-95	35-85	20-40	5-15
Otero-------------	0-5	Sandy loam--------	SM	A-2	0-1	95-100	75-100	50-80	25-35	20-25	NP-5
	5-60	Sandy loam, fine sandy loam.	SM	A-2, A-1	0-1	90-100	75-100	40-80	25-35	15-25	NP-5
Ku----------------- Kuma	0-8	Silt loam----------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	95-100	75-95	25-40	NP-15
	8-25	Silty clay loam, silt loam, loam.	CL	A-6, A-7	0	100	95-100	95-100	85-95	30-45	10-25
	25-60	Silty clay loam, loam, very fine sandy loam.	CL, CL-ML, ML	A-4, A-6	0	95-100	95-100	95-100	75-95	20-40	NP-15
Lm----------------- Limon	0-4	Silty clay--------	CL	A-7	0	100	95-100	95-100	70-90	40-60	20-40
	4-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	95-100	95-100	75-95	35-60	20-40
Mc----------------- Manter	0-16	Fine sandy loam	SM, SC, SM-SC, CL-ML	A-2, A-4	0	95-100	75-100	45-85	25-55	20-30	NP-10
	16-60	Fine sandy loam, sandy loam.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	95-100	75-100	50-85	30-55	15-25	NP-10
Mh----------------- Midway	0-4	Clay---------------	CL, CH	A-7	0	75-100	75-100	70-100	70-95	40-60	20-35
	4-12	Clay, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	35-50	15-25
	12	Weathered bedrock	---	---	---	---	---	---	---	---	---
Po----------------- Pleasant	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-25
	10-52	Silty clay loam, silty clay, clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-65	20-45
	52-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	95-100	80-100	25-45	NP-15
Rc----------------- Razor	0-6	Clay---------------	CL, CH	A-7	0-5	95-100	95-100	85-100	80-100	40-60	20-40
	6-24	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	90-100	80-100	35-60	20-45
	24-32	Silty clay, silty clay loam, clay.	CL, CH	A-6, A-7	0	90-100	90-100	80-100	75-100	35-60	20-45
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---
Sc----------------- Satanta	0-12	Loam---------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	80-100	55-80	22-36	2-15
	12-22	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	40-75	25-45	11-25
	22-60	Loam, clay loam, fine sandy loam.	ML, CL, SM, SC	A-4, A-6	0	100	95-100	60-100	40-80	20-36	2-15
Se----------------- Sweetwater	0-24	Clay loam---------	CL, CL-ML, SC	A-4, A-6	0	100	95-100	80-95	40-70	25-40	7-20
	24-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	95-100	90-100	50-80	15-35	<22	NP-2

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ua, Ub, Uc------- Ulysses	0-10	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	10-19	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	19-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Us*:											
Ulysses---------	0-10	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	10-19	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	19-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Colby-----------	0-4	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	4-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Bb---------------- Bankard	0-5	2-10	1.80-1.95	6.0-20	0.10-0.15	6.6-7.8	<2	Low--------	0.17	5	2	.5-1
	5-60	0-10	1.85-2.00	6.0-20	0.07-0.14	7.4-8.4	<2	Low--------	0.17			
Bc---------------- Bankard	0-5	5-20	1.50-1.60	2.0-6.0	0.13-0.15	7.4-8.4	<2	Low--------	0.24	5	3	1-2
	5-60	2-10	1.55-1.65	6.0-20	0.05-0.08	7.4-8.4	<2	Low--------	0.20			
Bo---------------- Bridgeport	0-16	14-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.32	5	6	1-4
	16-60	18-30	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Bp, Br------------ Bridgeport	0-12	14-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.32	5	6	1-4
	12-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43			
Bs*:												
Bridgeport------	0-6	14-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.32	5	6	1-4
	6-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43			
Arvada-----------	0-2	20-40	1.20-1.30	0.2-2.0	0.07-0.12	>7.8	>4	Moderate	0.32	5	4L	1-3
	2-22	35-60	1.30-1.50	<0.06	0.07-0.12	>8.4	>4	High-------	0.37			
	22-60	20-30	1.30-1.50	0.6-2.0	0.07-0.12	7.4-9.0	>4	Moderate	0.32			
Cd---------------- Canyon	0-4	12-20	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.32	2	4L	.5-1
	4-14	12-25	1.30-1.50	0.6-2.0	0.13-0.18	7.4-8.4	<2	Low--------	0.43			
	14	---	---	---	---	---	---	-----------	----			
Ch---------------- Caruso	0-16	18-27	1.30-1.40	0.6-2.0	0.19-0.23	7.4-8.4	<4	Low--------	0.28	5	4L	1-4
	16-60	18-35	1.35-1.50	0.2-2.0	0.16-0.22	7.4-8.4	<4	Low--------	0.28			
Co, Cp------------ Colby	0-5	15-30	1.20-1.30	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-2
	5-60	18-27	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Ec---------------- Elkader	0-10	15-27	1.20-1.35	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	1-3
	10-18	18-35	1.25-1.40	0.6-2.0	0.17-0.22	7.9-8.4	<2	Low--------	0.43			
	18-60	18-35	1.25-1.40	0.6-2.0	0.15-0.22	7.9-9.0	2-16	Low--------	0.43			
Gb---------------- Glenberg	0-30	10-20	1.45-1.50	2.0-6.0	0.09-0.13	7.4-8.4	<2	Low--------	0.24	5	3	.5-1
	30-60	8-18	1.45-1.50	2.0-6.0	0.07-0.12	7.4-9.0	<2	Low--------	0.24			
Go---------------- Goshen	0-16	18-27	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-3
	16-39	25-35	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.43			
	39-60	15-27	1.20-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Ke---------------- Keith	0-9	15-25	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-3
	9-24	20-35	1.10-1.20	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.32			
	24-60	10-20	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.43			
Ko*:												
Kim--------------	0-6	15-27	1.30-1.40	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low--------	0.32	5	4L	.5-1
	6-60	20-35	1.40-1.50	0.6-2.0	0.15-0.17	7.9-8.4	<8	Low--------	0.32			
Otero------------	0-5	10-20	1.40-1.45	2.0-6.0	0.11-0.13	7.4-8.4	<2	Low--------	0.20	5	3	.5-2
	5-60	5-18	1.45-1.50	2.0-6.0	0.08-0.12	7.4-8.4	<4	Low--------	0.17			
Ku---------------- Kuma	0-8	15-27	1.20-1.30	0.6-2.0	0.18-0.21	6.1-8.4	<2	Low--------	0.32	5	6	2-4
	8-25	18-35	1.25-1.35	0.6-2.0	0.18-0.21	6.6-8.4	<2	Moderate	0.37			
	25-60	10-30	1.40-1.50	0.6-2.0	0.16-0.18	7.9-9.0	<2	Low--------	0.32			
Lm---------------- Limon	0-4	40-60	1.30-1.40	0.2-0.6	0.14-0.17	7.4-8.4	2-8	High-------	0.24	5	4	.5-1
	4-60	35-60	1.35-1.45	0.06-0.2	0.12-0.16	7.9-9.0	2-8	High-------	0.32			
Mc---------------- Manter	0-16	10-20	1.35-1.40	2.0-6.0	0.12-0.16	6.6-7.8	<2	Low--------	0.15	5	3	2-4
	16-60	9-18	1.40-1.50	2.0-6.0	0.11-0.14	6.6-8.4	<2	Low--------	0.15			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Mh---------------- Midway	0-4	40-60	1.30-1.40	0.06-0.2	0.14-0.18	6.6-8.4	2-4	High------	0.43	1	4	.5-2
	4-12	35-45	1.35-1.45	0.06-0.2	0.14-0.18	7.9-9.0	2-8	High------	0.43			
	12	---	---	---	---	---	---	----------	----			
Po---------------- Pleasant	0-10	27-40	1.10-1.30	0.2-0.6	0.19-0.21	6.6-7.3	<2	Moderate	0.24	3	7	2-5
	10-52	35-45	1.10-1.30	<0.06	0.14-0.18	6.6-7.8	<2	High------	0.24			
	52-60	20-32	1.10-1.30	0.6-2.0	0.18-0.20	7.4-8.4	<2	Low-------	0.24			
Rc---------------- Razor	0-6	40-50	1.35-1.40	0.06-0.2	0.15-0.18	6.6-8.4	<2	High------	0.28	2	4	.5-2
	6-24	35-60	1.30-1.40	0.06-0.2	0.15-0.18	7.4-8.4	<2	High------	0.28			
	24-32	35-60	1.30-1.40	0.06-0.2	0.15-0.18	7.4-8.4	>8	High------	0.28			
	32	---	---	---	---	---	---	----------	----			
Sc---------------- Satanta	0-12	10-25	1.30-1.40	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low-------	0.28	5	6	1-2
	12-22	18-35	1.35-1.45	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate	0.28			
	22-60	10-28	1.35-1.50	0.6-2.0	0.16-0.19	7.4-8.4	<2	Low-------	0.28			
Se---------------- Sweetwater	0-24	18-35	1.35-1.55	0.2-0.6	0.16-0.20	7.4-8.4	<2	Low-------	0.28	3	7	1-4
	24-60	3-15	1.50-1.70	6.0-20	0.04-0.10	7.9-8.4	<2	Very low	0.17			
Ua, Ub, Uc-------- Ulysses	0-10	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.32	5	6	1-3
	10-19	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.43			
	19-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low-------	0.43			
Us*:												
Ulysses----------	0-10	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-------	0.32	5	6	1-3
	10-19	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.43			
	19-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low-------	0.43			
Colby------------	0-4	15-30	1.20-1.30	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.43	5	4L	.5-2
	4-60	18-27	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.43			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Bb: Bankard	A	Occasional	Very brief	Mar-Aug	>6.0	---	---	>60	---	Low	Moderate	Low.
Bc: Bankard	A	Rare	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Bo: Bridgeport	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Bp: Bridgeport	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Br: Bridgeport	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Bs*:												
Bridgeport	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Arvada	D	Rare	---	---	>6.0	---	---	>60	---	Low	High	High.
Cd: Canyon	D	None	---	---	>6.0	---	---	6-20	Soft	Low	High	Low.
Ch: Caruso	C	Occasional	Very brief	Apr-Sep	2.0-3.0	Apparent	Mar-Jun	>60	---	Moderate	High	Moderate.
Co, Cp: Colby	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Ec: Elkader	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Gb: Glenberg	B	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Go: Goshen	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
Ke: Keith	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ko*:												
Kim	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Otero	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Ku: Kuma	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic	Flooding			High water table			Bedrock		Potential frost	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated	Concrete
					Ft			In				
Lm----------------- Limon	C	Rare---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Moderate.
Mc----------------- Manter	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Mh----------------- Midway	D	None---------	---	---	>6.0	---	---	6-20	Soft	Low-------	High------	Low.
Po----------------- Pleasant	D	None---------	---	---	+2-0	Perched	Apr-Sep	>60	---	Low-------	High------	Low.
Rc----------------- Razor	C	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High------	High.
Sc----------------- Satanta	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Se----------------- Sweetwater	D	Occasional	Brief-----	Apr-Oct	0.5-3.0	Apparent	Jan-Dec	>60	---	Moderate	High------	Low.
Ua, Ub, Uc--------- Ulysses	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Us*:												
Ulysses-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Colby-------------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. LL means liquid limit; PI, plasticity index; MD, maximum dry density; OM, optimum moisture; and NP, nonplastic)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than--						
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			MD	OM
										Pct		Lb/ft3	Pct
Bankard sandy loam: (S82KS-199-001)													
A------ 0 to 5	A-2	SM-SC	100	98	66	29	16	5	2	23	6	121	9
C------ 12 to 60	A-2	SP-SM	100	93	41	5	1	0	0	--	NP	113	12
Colby silt loam: (S82KS-199-002)													
A------ 0 to 5	A-6	CL	100	100	98	92	37	13	7	33	11	100	20
C------ 11 to 60	A-4	ML	100	100	96	87	43	14	4	33	9	96	22
Goshen silt loam: (S82KS-199-003)													
A1----- 0 to 8	A-6	CL	100	100	98	90	50	18	9	39	14	93	22
Bt1---- 16 to 30	A-6	CL	100	100	98	89	48	23	12	36	14	99	20
C------ 48 to 60	A-6	CL	100	100	97	85	41	19	11	31	11	103	17
Kim loam: (S82KS-199-004)													
A------ 0 to 6	A-4	CL-ML	100	98	85	74	30	11	6	28	7	107	14
AC----- 6 to 18	A-4	CL-ML	100	98	80	63	24	8	4	23	5	118	11
C1----- 18 to 52	A-4	SC	100	97	53	36	23	13	8	31	10	117	12
Manter fine sandy loam: (S82KS-199-005)													
A1----- 0 to 8	A-2-4	SM-SC	100	100	72	39	18	8	4	24	7	119	10
Bt----- 16 to 26	A-2-4	SC	100	100	72	40	23	11	8	25	9	121	11
C------ 36 to 60	A-2-4	SM-SC	100	100	65	31	16	11	8	22	6	123	9
Pleasant silty clay loam: (S82KS-199-006)													
A------ 0 to 5	A-7-6	CL	100	100	100	97	62	33	21	42	18	90	26
Bt1---- 10 to 26	A-7-6	CL	100	100	100	97	67	42	28	48	23	91	24
C------ 52 to 60	A-7-6	CL	100	100	98	84	43	14	6	41	15	95	23
Razor clay: (S82KS-199-007)													
A------ 0 to 6	A-7-6	CH	100	100	92	83	58	32	20	50	23	90	27
Bw----- 16 to 24	A-7-6	CH	100	100	99	85	70	52	27	51	21	90	31

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Arvada	Fine, montmorillonitic, mesic Ustollic Natrargids
Bankard	Sandy, mixed, mesic Ustic Torrifluvents
Bridgeport	Fine-silty, mixed, mesic Fluventic Haplustolls
Canyon	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Caruso	Fine-loamy, mixed, mesic Fluvaquentic Haplustolls
Colby	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Elkader	Fine-silty, mixed, mesic Torriorthentic Haplustolls
Glenberg	Coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Goshen	Fine-silty, mixed, mesic Pachic Argiustolls
Keith	Fine-silty, mixed, mesic Aridic Argiustolls
Kim	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Kuma	Fine-silty, mixed, mesic Pachic Argiustolls
Limon	Fine, montmorillonitic (calcareous), mesic Ustertic Torriorthents
Manter	Coarse-loamy, mixed, mesic Aridic Argiustolls
Midway	Clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents
Otero	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Pleasant	Fine, montmorillonitic, mesic Torrertic Argiustolls
Razor	Fine, montmorillonitic, mesic Ustollic Camborthids
Satanta	Fine-loamy, mixed, mesic Aridic Argiustolls
*Sweetwater	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), thermic Fluvaquentic Haplaquolls
Ulysses	Fine-silty, mixed, mesic Aridic Haplustolls

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Map symbol	Soil name	Land capability* N	Land capability* I	Prime farmland*	Range site
Bb	Bankard loamy sand, occasionally flooded	VIw	---	No	Sands.
Bc	Bankard sandy loam	VIs	IVs	No	Sandy.
Bo	Bridgeport loam, occasionally flooded	IIIw	IIw	Yes**	Loamy Lowland.
Bp	Bridgeport silt loam, 0 to 2 percent slopes	IIIc	I	Yes**	Loamy Terrace.
Br	Bridgeport silt loam, 2 to 6 percent slopes	IIIe	IIIe	Yes**	Loamy Terrace.
Bs	Bridgeport-Arvada complex	VIs	IVs	No	
	Bridgeport				Loamy Terrace.
	Arvada				Saline Lowland.
Cd	Canyon loam, 5 to 30 percent slopes	VIs	---	No	Shallow Limy.
Ch	Caruso loam, occasionally flooded	IIIw	IIw	Yes**	Subirrigated.
Co	Colby silt loam, 3 to 6 percent slopes	IVe	IVe	Yes**	Limy Upland.
Cp	Colby silt loam, 6 to 15 percent slopes	VIe	---	No	Limy Upland.
Ec	Elkader silt loam, 2 to 6 percent slopes	IVe	IIIe	No	Limy Upland.
Gb	Glenberg sandy loam	IIIe	IIe	No	Sandy Terrace.
Go	Goshen silt loam	IIIc	I	Yes**	Loamy Terrace.
Ke	Keith silt loam, 0 to 1 percent slopes	IIIc	I	Yes**	Loamy Upland.
Ko	Kim-Otero complex, 5 to 20 percent slopes	VIe	---	No	
	Kim				Limy Upland.
	Otero				Sandy.
Ku	Kuma silt loam, 0 to 1 percent slopes	IIIc	I	Yes**	Loamy Upland.
Lm	Limon silty clay, 0 to 2 percent slopes	IVs	IIIs	No	Clay Terrace.
Mc	Manter fine sandy loam, 2 to 5 percent slopes	IVe	IIIe	No	Sandy.
Mh	Midway clay, 5 to 20 percent slopes	VIe	---	No	Shale Breaks.
Po	Pleasant silty clay loam	IVw	IVw	No	Clay Upland.
Rc	Razor clay, 1 to 6 percent slopes	IVe	IVe	No	Clay Upland.
Sc	Satanta loam, 1 to 3 percent slopes	IIIe	IIe	Yes**	Loamy Upland.
Se	Sweetwater clay loam, occasionally flooded	Vw	---	No	Subirrigated.
Ua	Ulysses silt loam, 0 to 1 percent slopes	IIIc	I	Yes**	Loamy Upland.
Ub	Ulysses silt loam, 1 to 3 percent slopes	IIIe	IIe	Yes**	Loamy Upland.
Uc	Ulysses silt loam, 3 to 6 percent slopes	IVe	IIIe	Yes**	Loamy Upland.
Us	Ulysses-Colby complex, 1 to 4 percent slopes	IIIe	IIe	Yes**	
	Ulysses				Loamy Upland.
	Colby				Limy Upland.

* The N column is for nonirrigated soils; the I column is for irrigated soils. A soil complex is treated as a single management unit in the land capability classification and prime farmland columns.
** Where irrigated.

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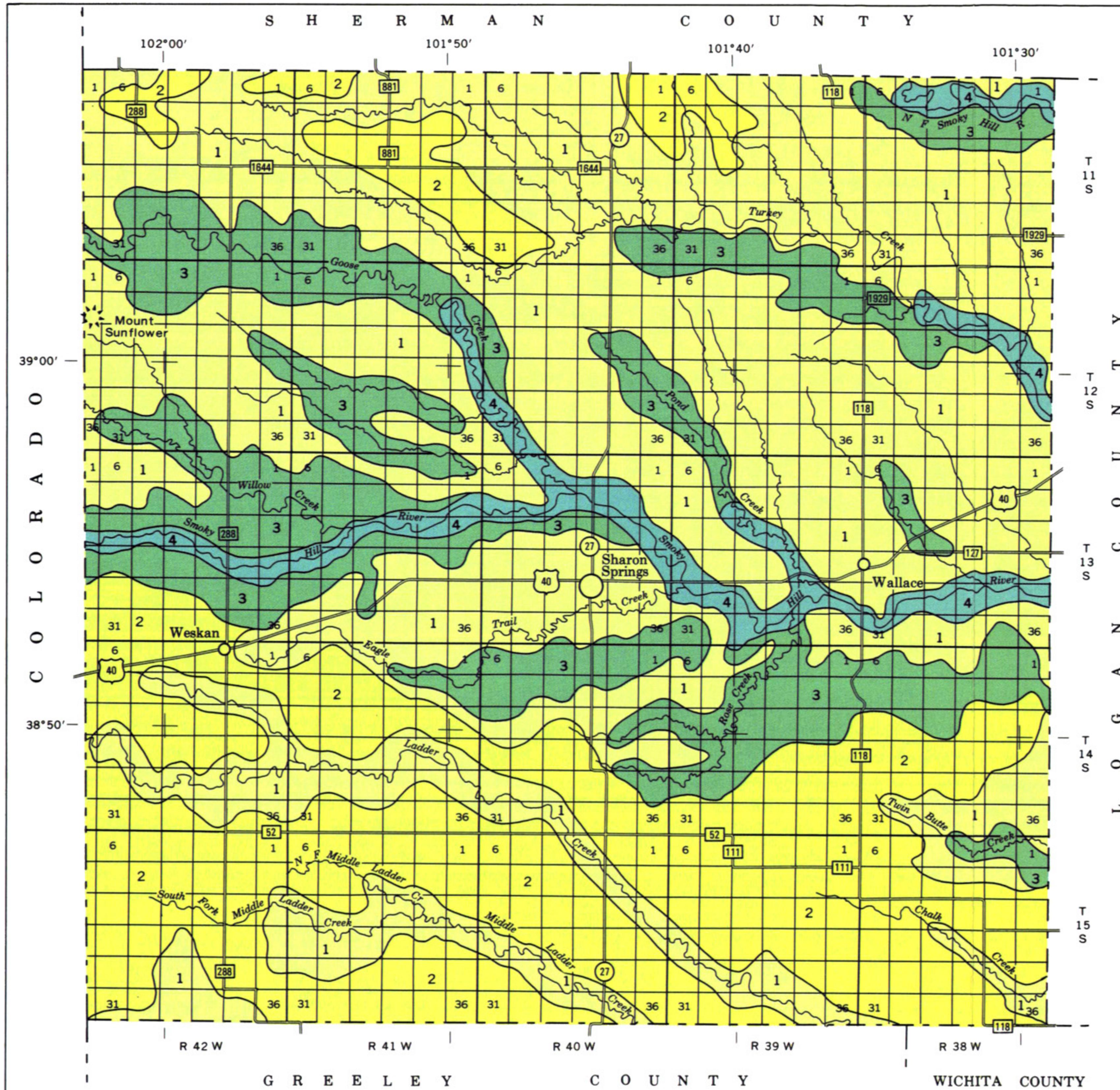


SOIL LEGEND

1	ULYSSES-COLBY association: Deep, nearly level to strongly sloping, well drained soils that have a silty subsoil; on uplands
2	KEITH-ULYSSES association: Deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands
3	COLBY-KIM-MIDWAY association: Deep and shallow, moderately sloping to moderately steep, well drained soils that have a silty, loamy, or clayey subsoil; on uplands
4	BRIDGEPORT-BANKARD association: Deep, nearly level to moderately sloping, well drained and somewhat excessively drained soils that have a silty or sandy subsoil; on stream terraces, flood plains, and alluvial fans

Compiled 1984

N

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

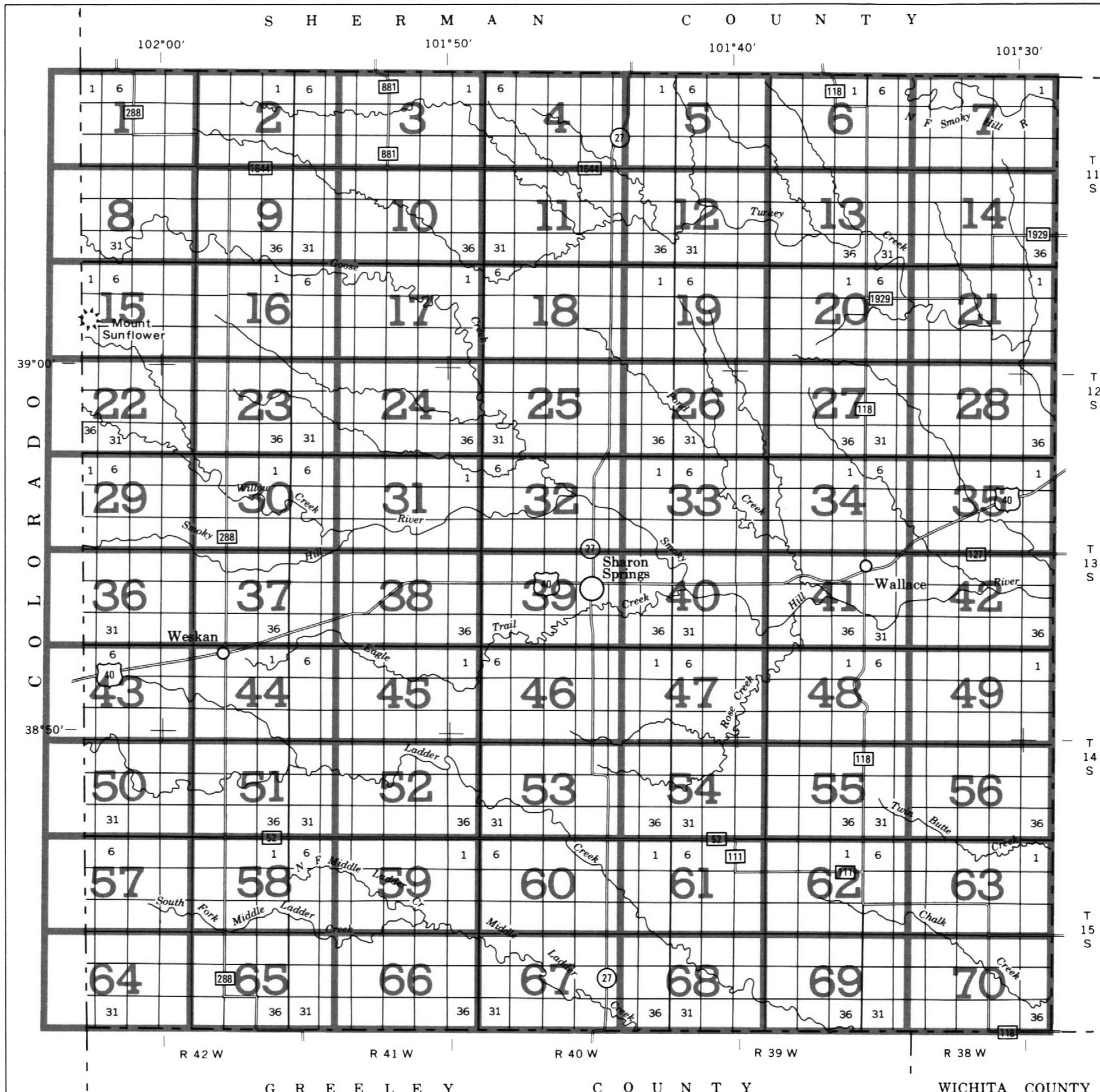
WALLACE COUNTY, KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



N

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

INDEX TO MAP SHEETS
WALLACE COUNTY, KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

SYMBOL	NAME
Bb	Bankard loamy sand, occasionally flooded
Bc	Bankard sandy loam
Bo	Bridgeport loam, occasionally flooded
Bp	Bridgeport silt loam, 0 to 2 percent slopes
Br	Bridgeport silt loam, 2 to 6 percent slopes
Bs	Bridgeport-Arvada complex
Cd	Canyon loam, 5 to 30 percent slopes
Ch	Caruso loam, occasionally flooded
Co	Colby silt loam, 3 to 6 percent slopes
Cp	Colby silt loam, 6 to 15 percent slopes
Ec	Elkader silt loam, 2 to 6 percent slopes
Gb	Glenberg sandy loam
Go	Goshen silt loam
Ke	Keith silt loam, 0 to 1 percent slopes
Ko	Kim-Otero complex, 5 to 20 percent slopes
Ku	Kuma silt loam, 0 to 1 percent slopes
Lm	Limon silty clay, 0 to 2 percent slopes
Mc	Manter fine sandy loam, 2 to 5 percent slopes
Mh	Midway clay, 5 to 20 percent slopes
Po	Pleasant silty clay loam
Rc	Razor clay, 1 to 6 percent slopes
Sc	Satanta loam, 1 to 3 percent slopes
Se	Sweetwater clay loam, occasionally flooded
Ua	Ulysses silt loam, 0 to 1 percent slopes
Ub	Ulysses silt loam, 1 to 3 percent slopes
Uc	Ulysses silt loam, 3 to 6 percent slopes
Us	Ulysses-Colby complex, 1 to 4 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label) — Hedley Airstrip

- Small airport, airfield, park, oilfield, cemetery, or flood pool — FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water, w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — Mc Po

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

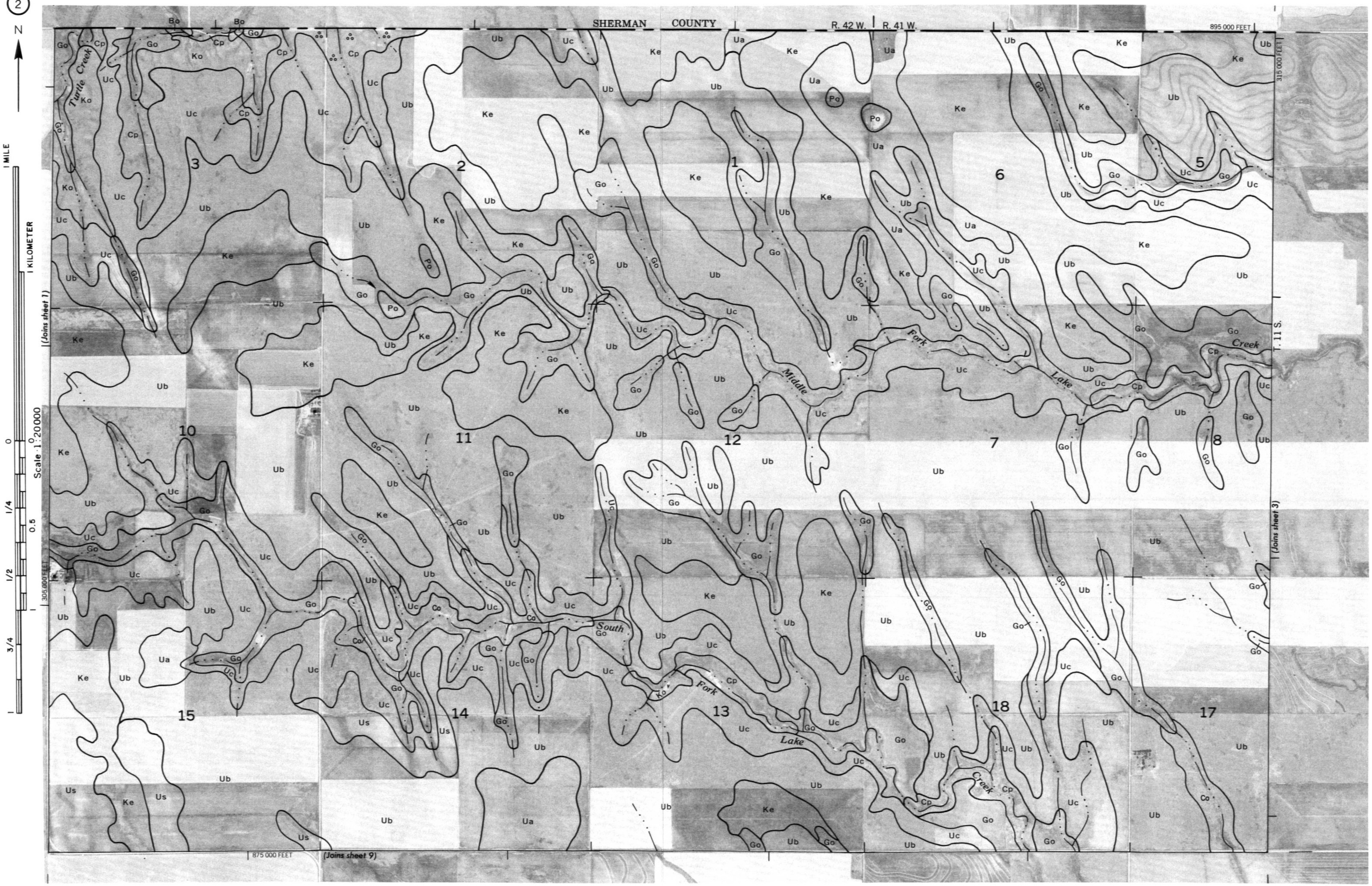
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 1

WALLACE COUNTY, KANSAS NO. 1

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 2



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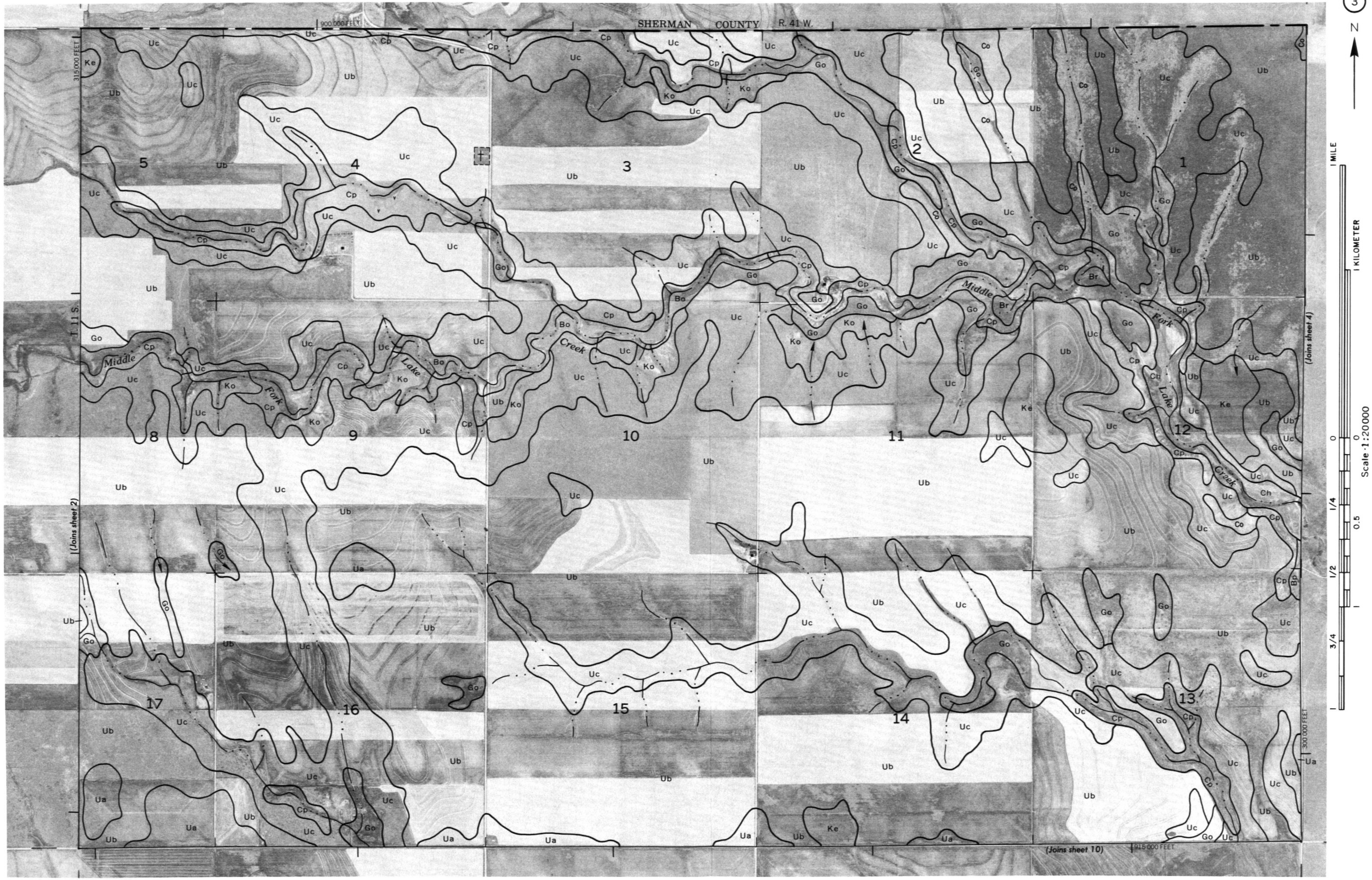
WALLACE COUNTY, KANSAS NO. 2

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 3

3



WALLACE COUNTY, KANSAS NO. 3

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

4

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 4

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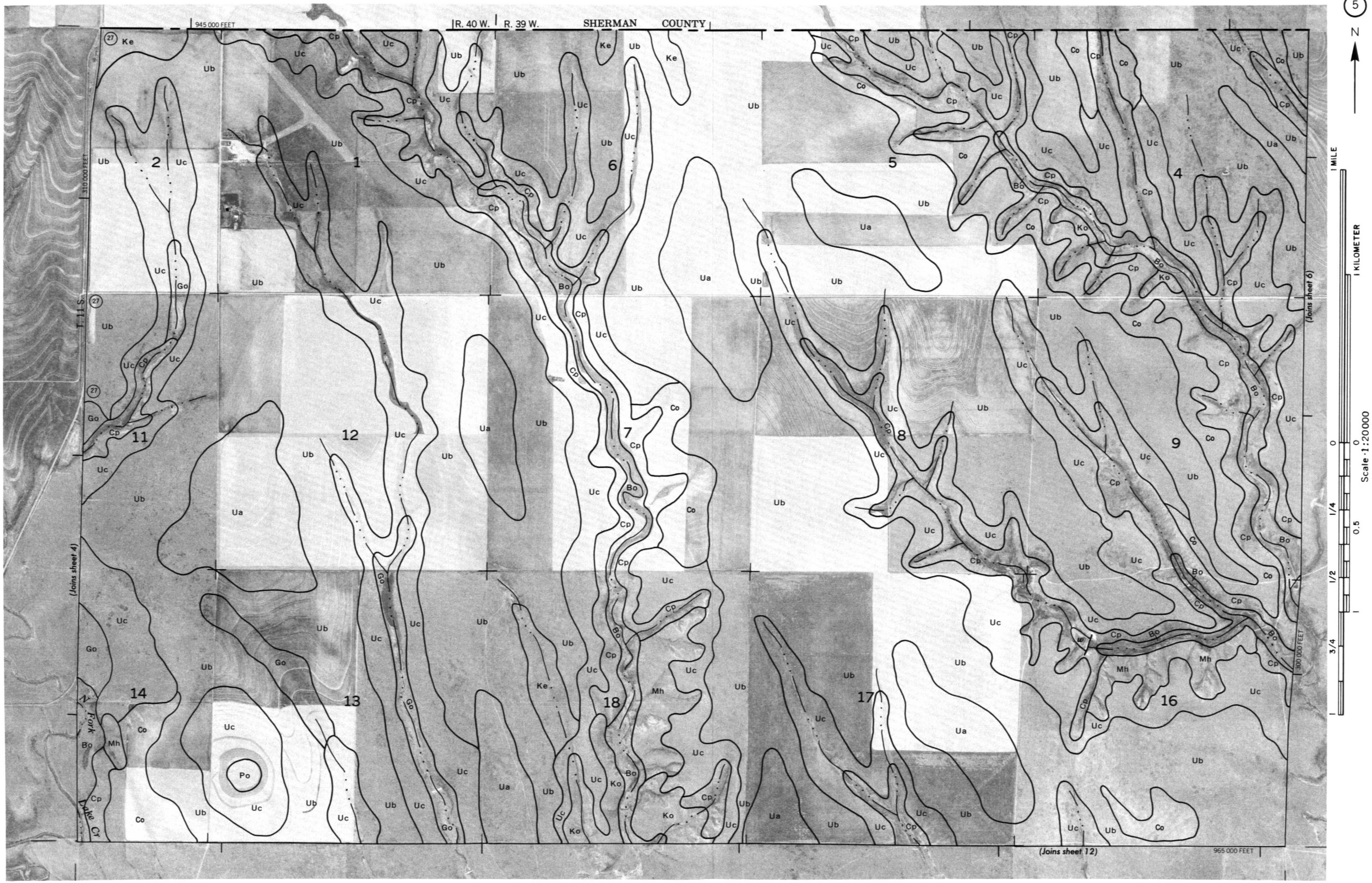
WALLACE COUNTY, KANSAS NO. 4

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 5



WALLACE COUNTY, KANSAS NO. 5

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SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 6

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WALLACE COUNTY, KANSAS NO. 6

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 7

WALLACE COUNTY, KANSAS NO. 7

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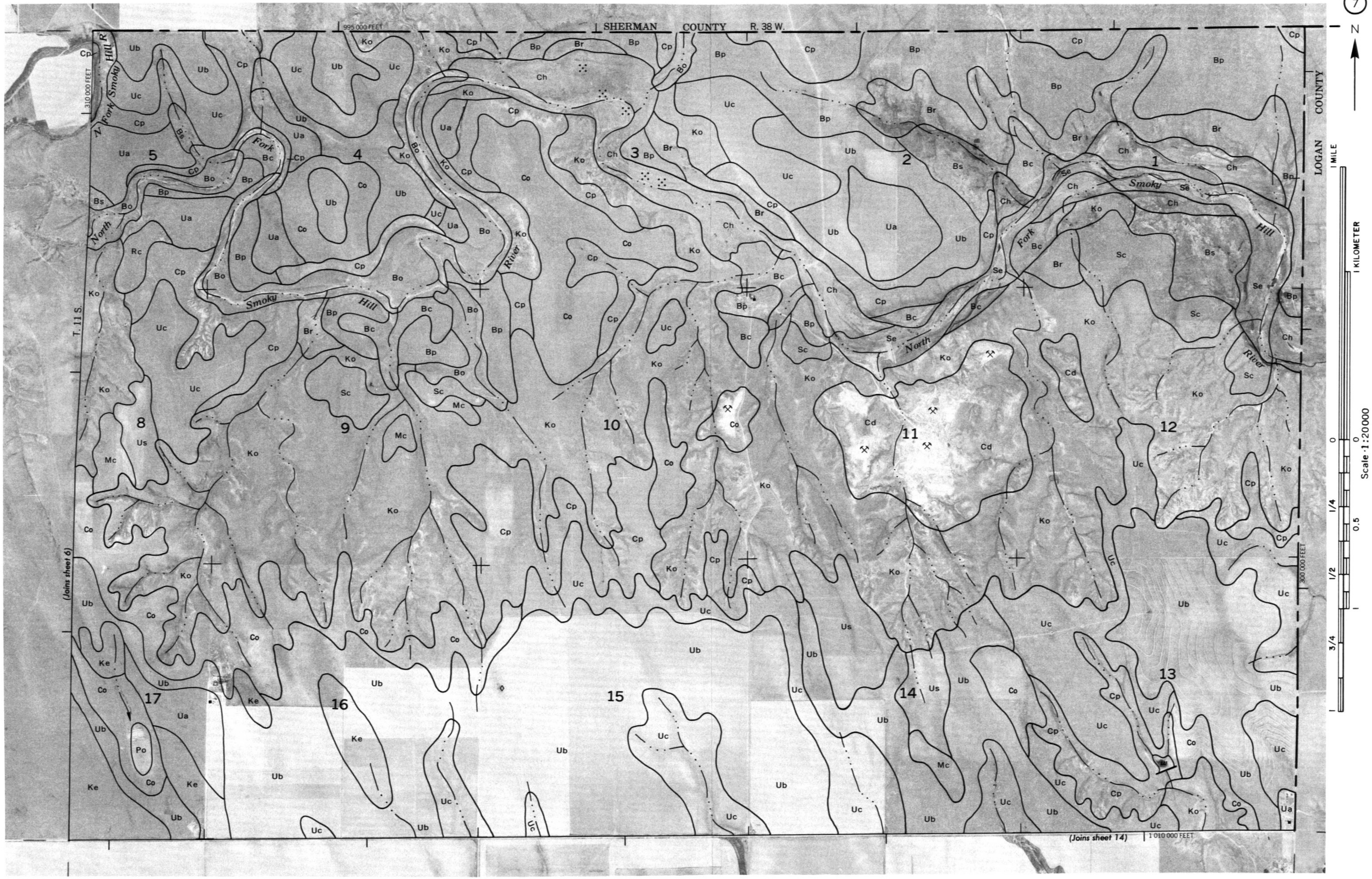
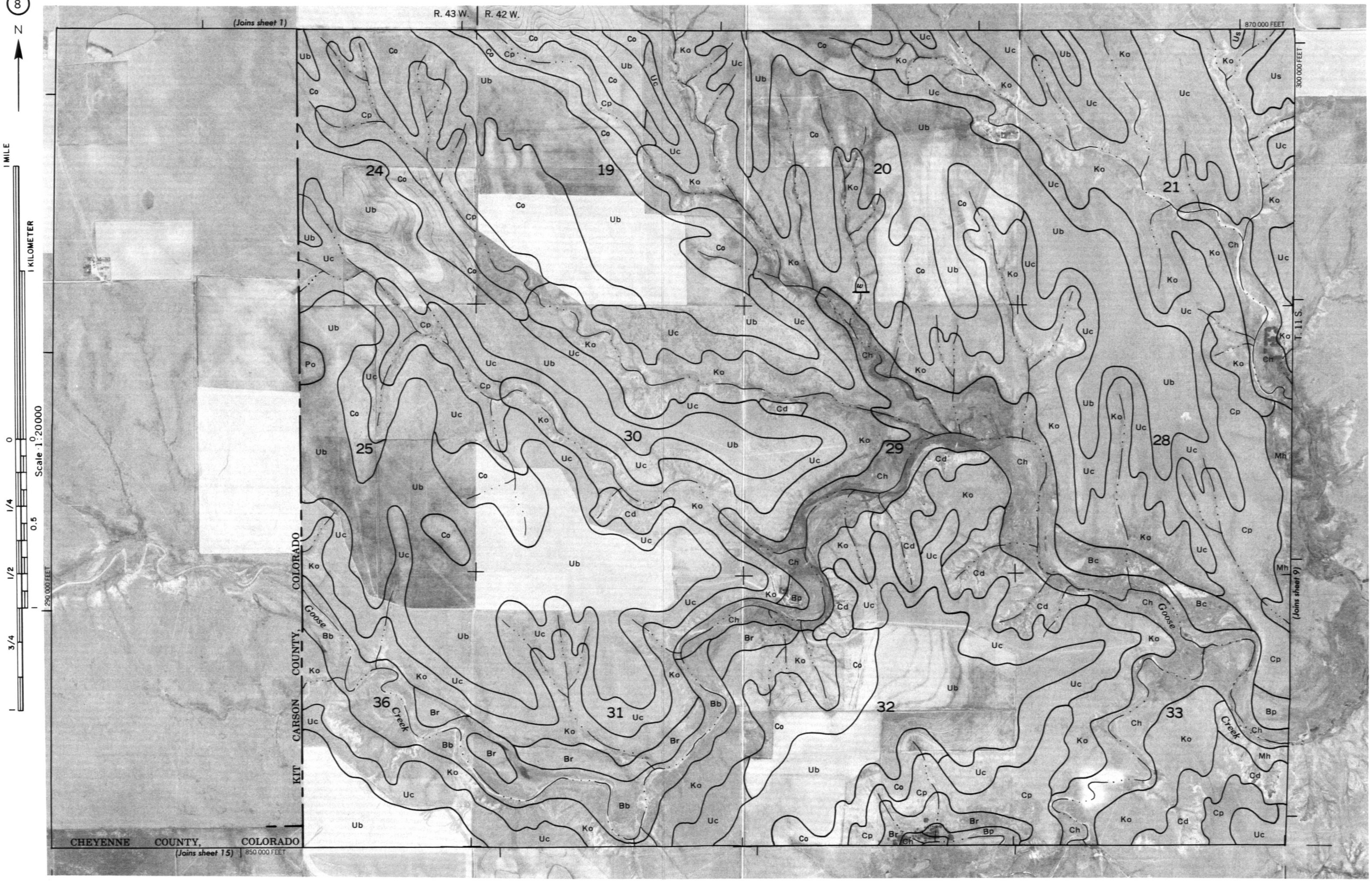


8

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 8



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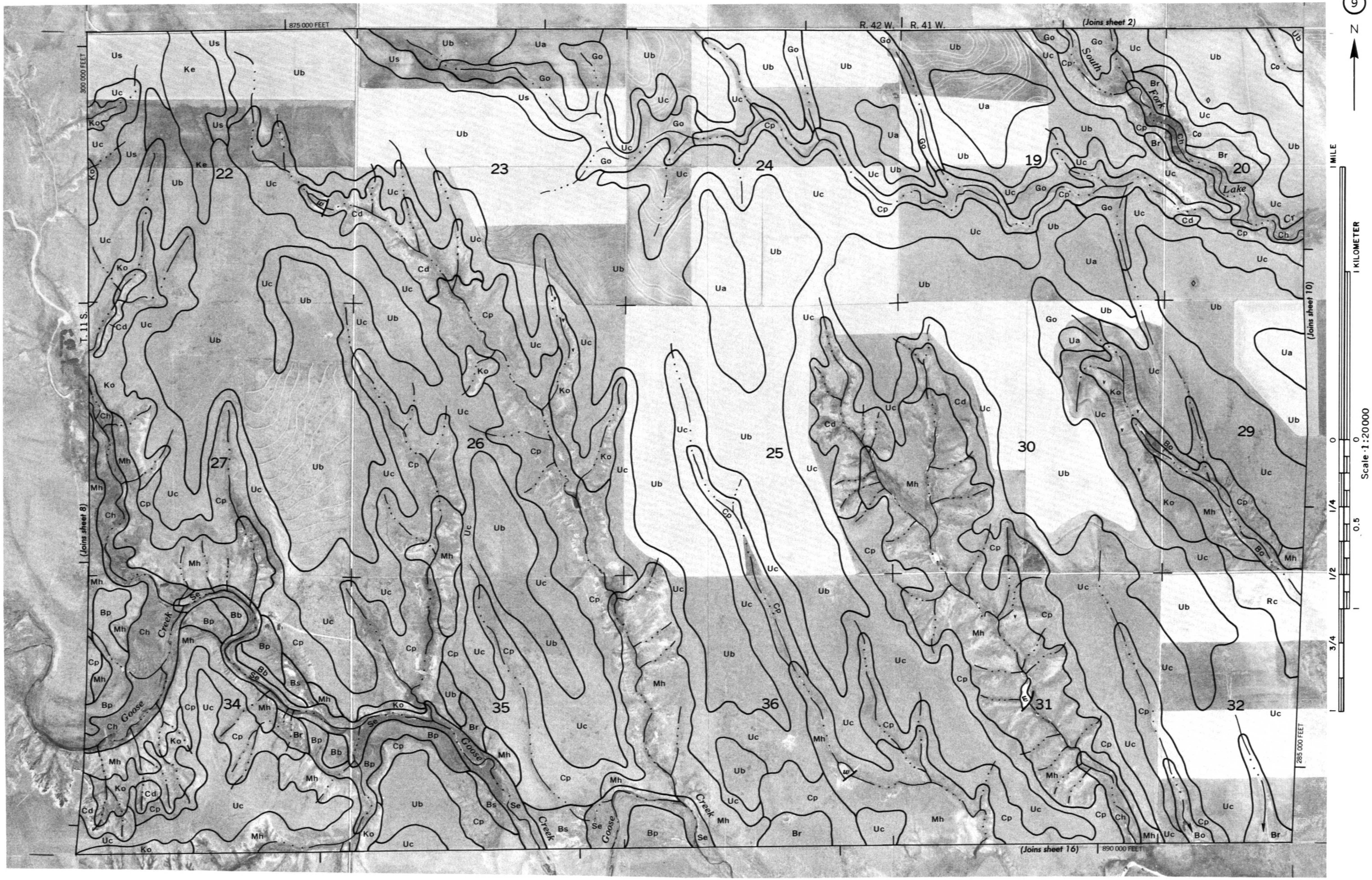
WALLACE COUNTY, KANSAS NO. 8

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 9



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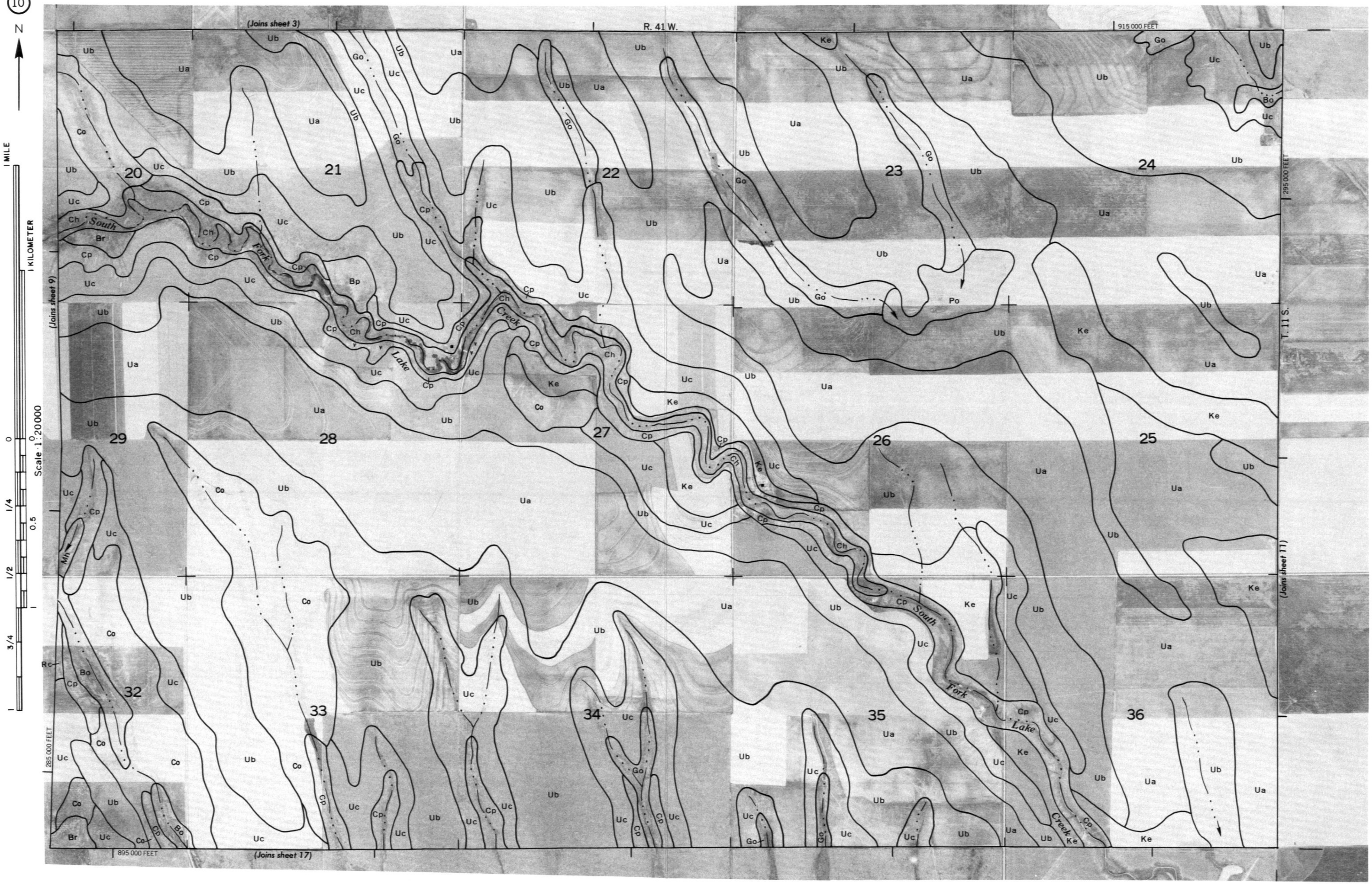
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 10



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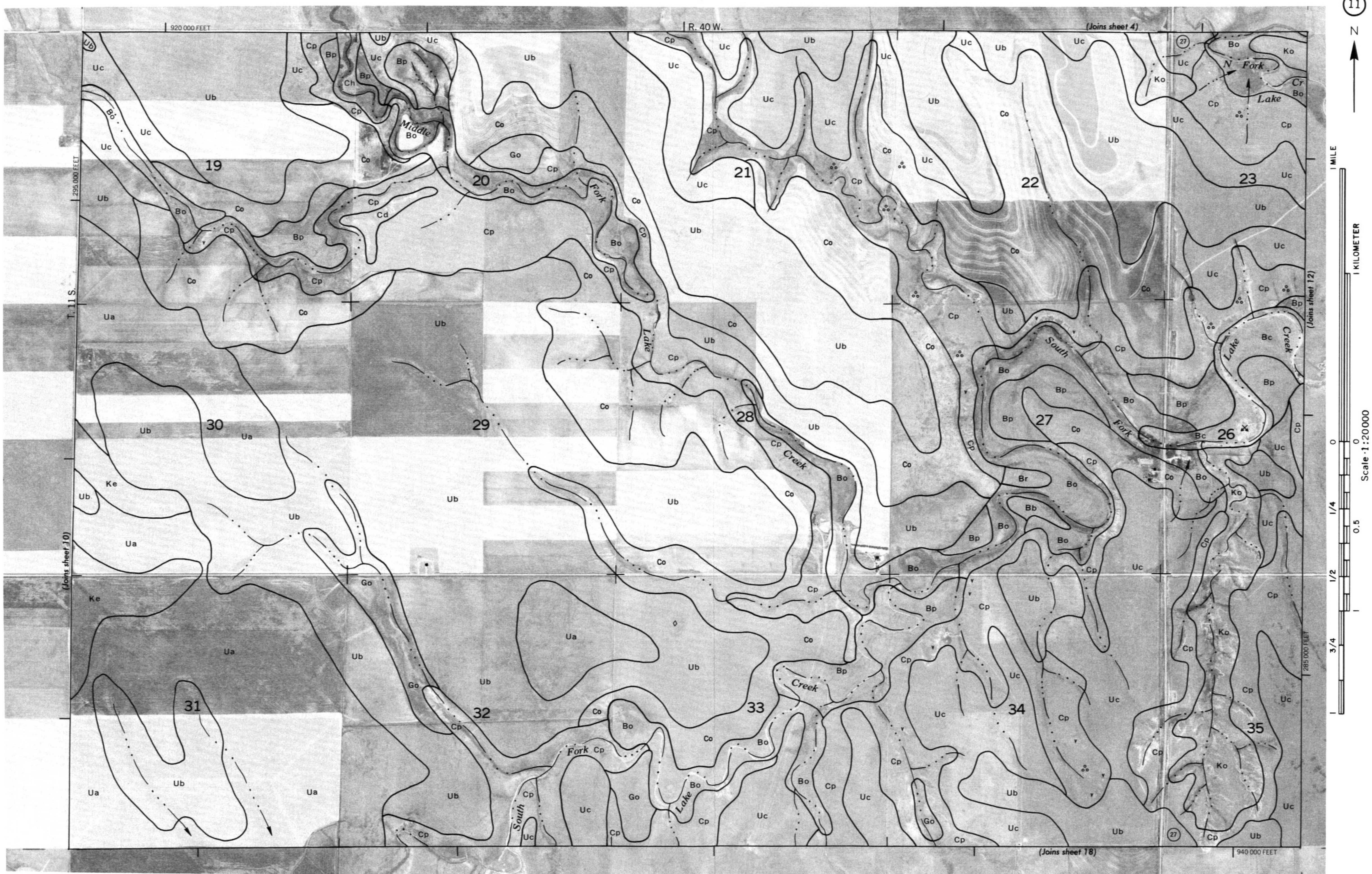
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 11



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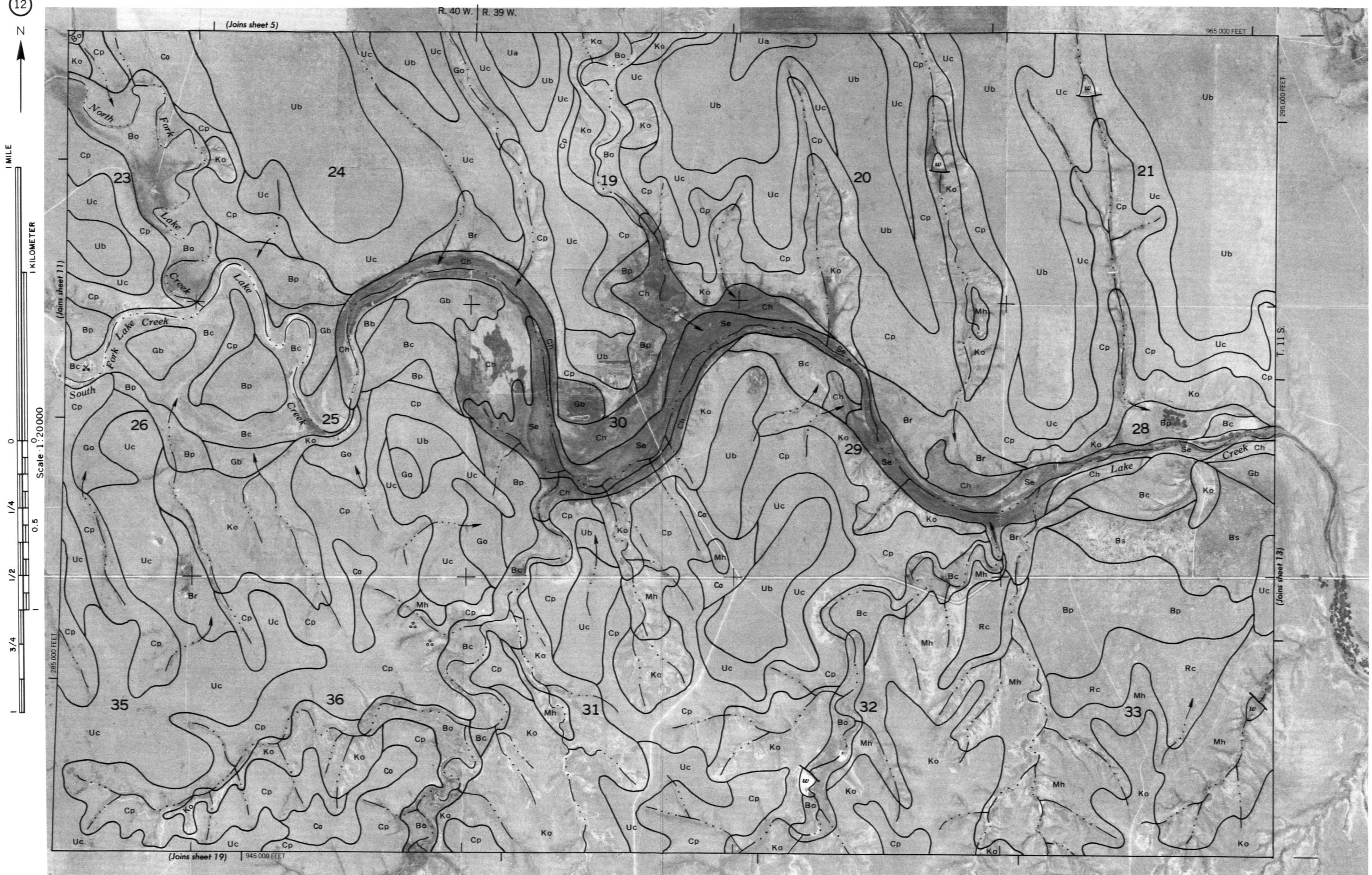
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 12



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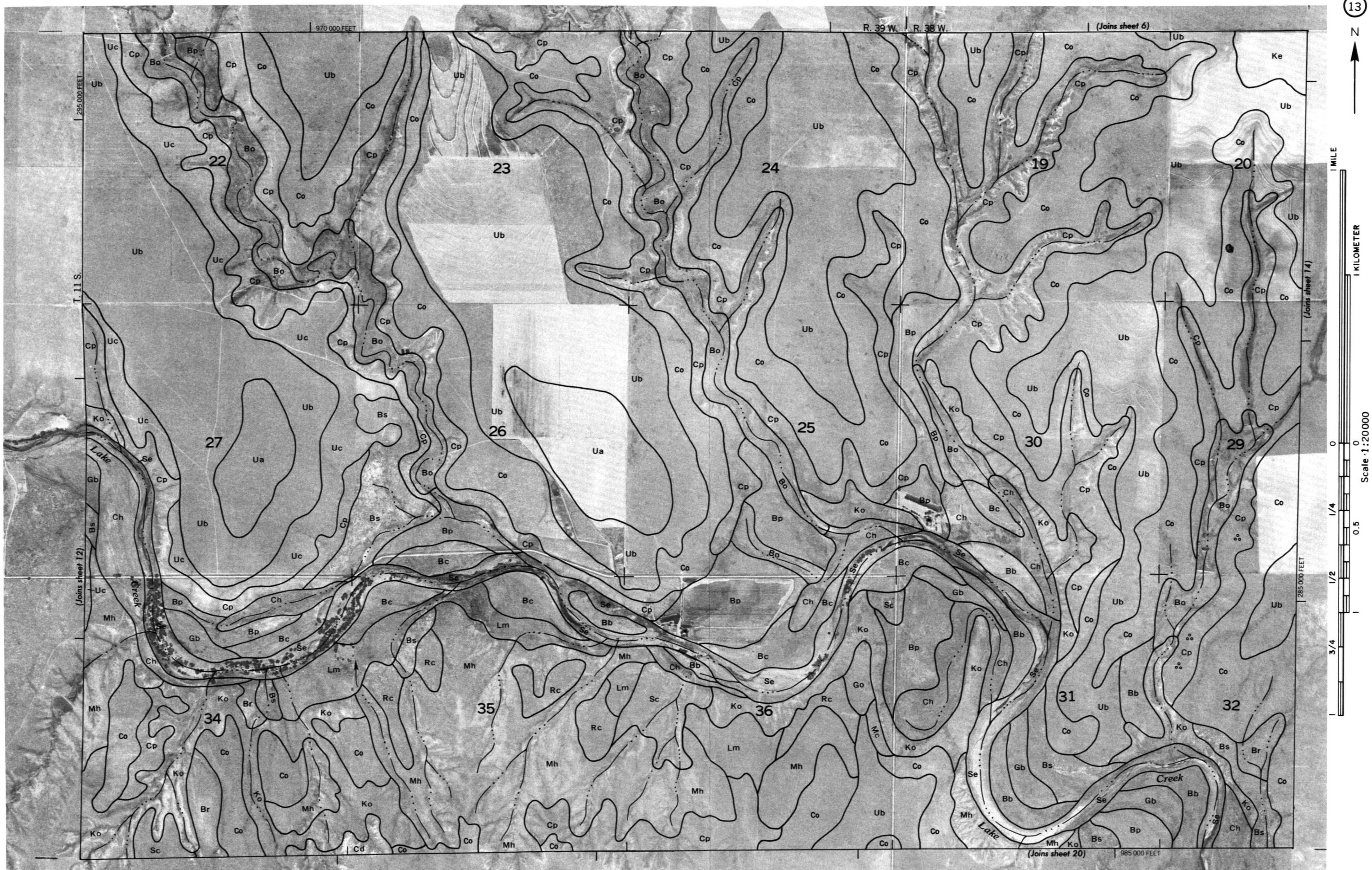
WALLACE COUNTY, KANSAS NO. 12

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 13



WALLACE COUNTY, KANSAS NO. 13

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

14

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 14

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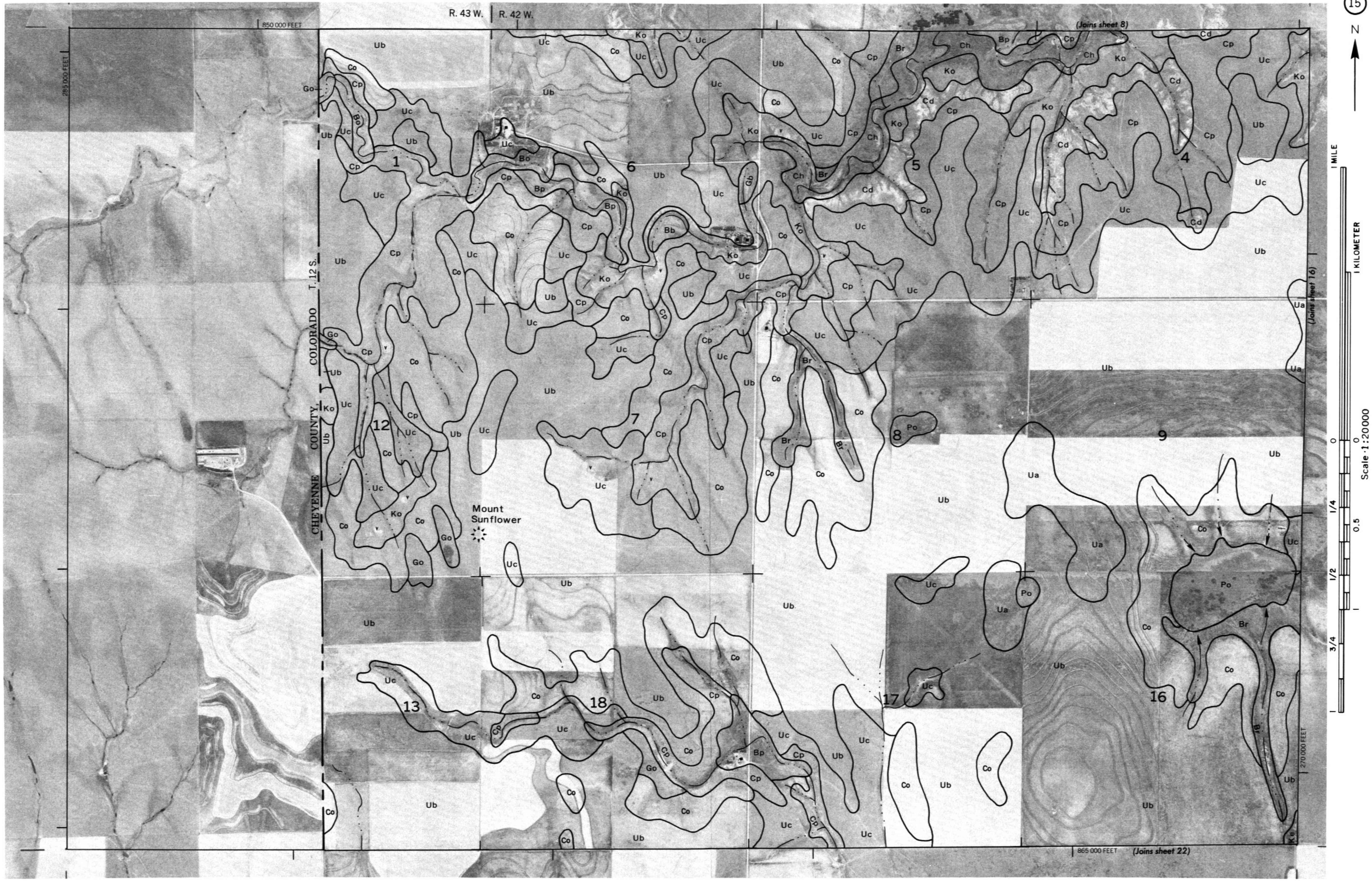
WALLACE COUNTY, KANSAS NO. 14



WALLACE COUNTY, KANSAS NO. 15

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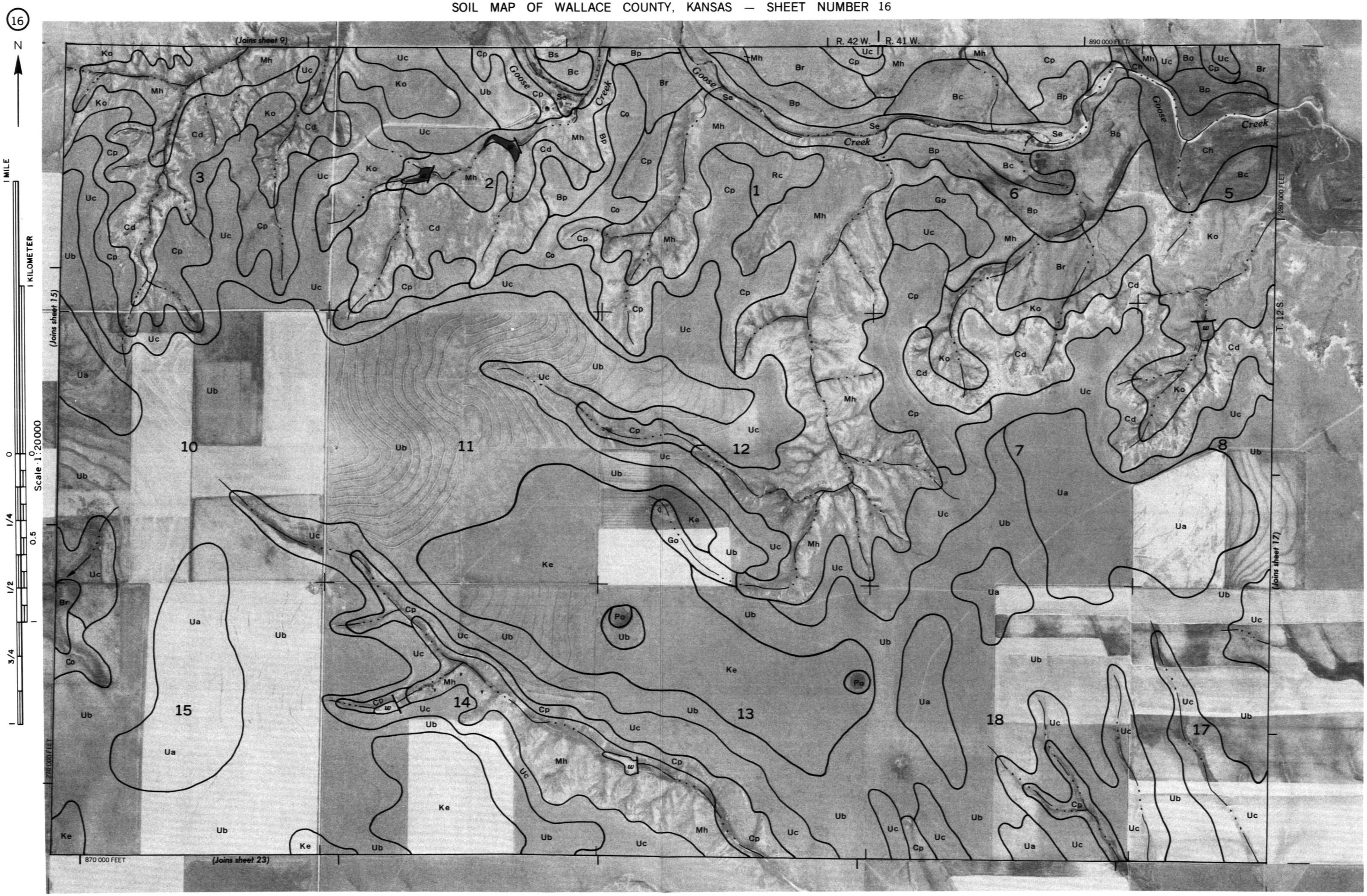
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 16



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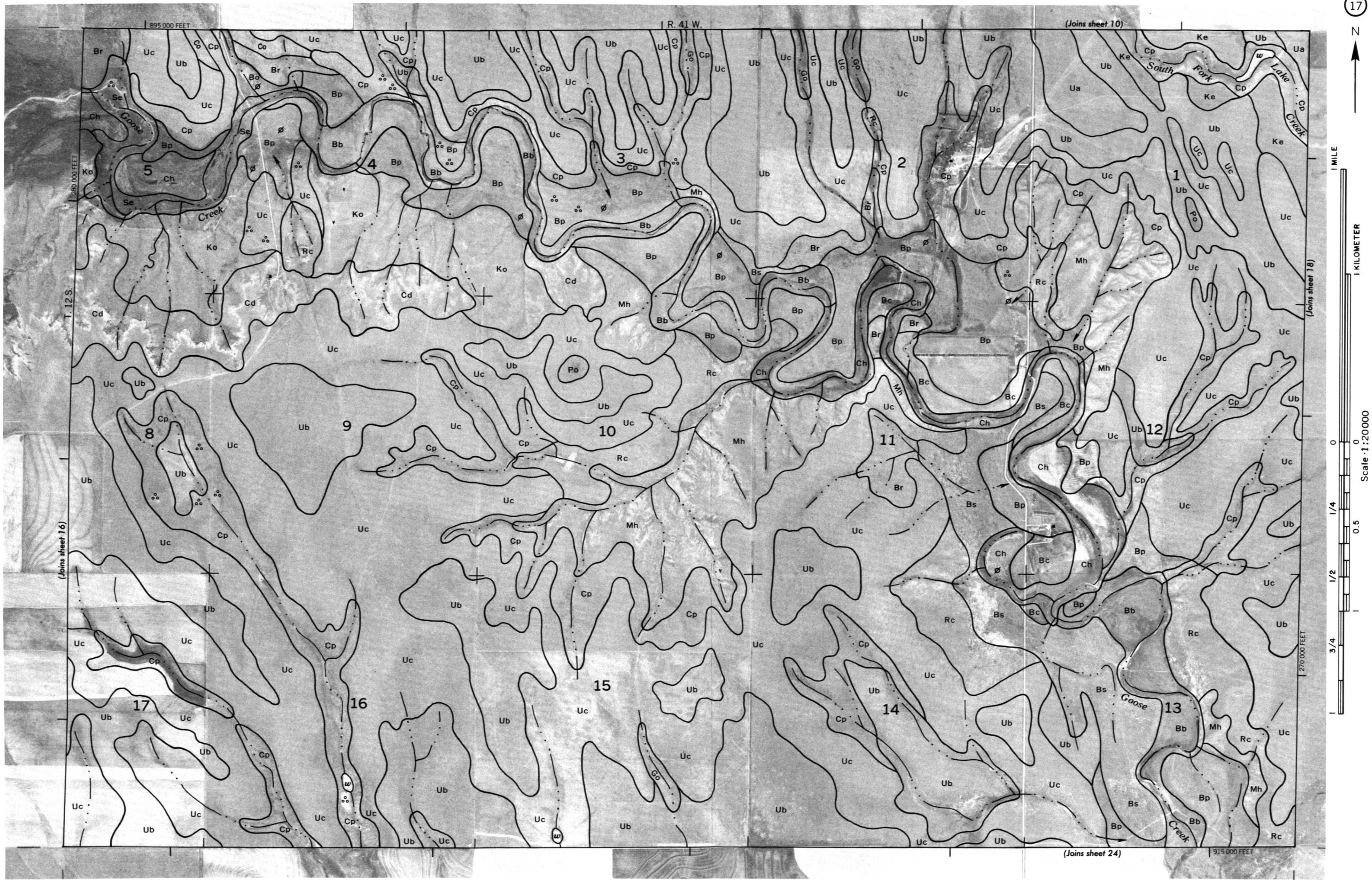
WALLACE COUNTY, KANSAS NO. 16

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 17



WALLACE COUNTY, KANSAS NO. 17

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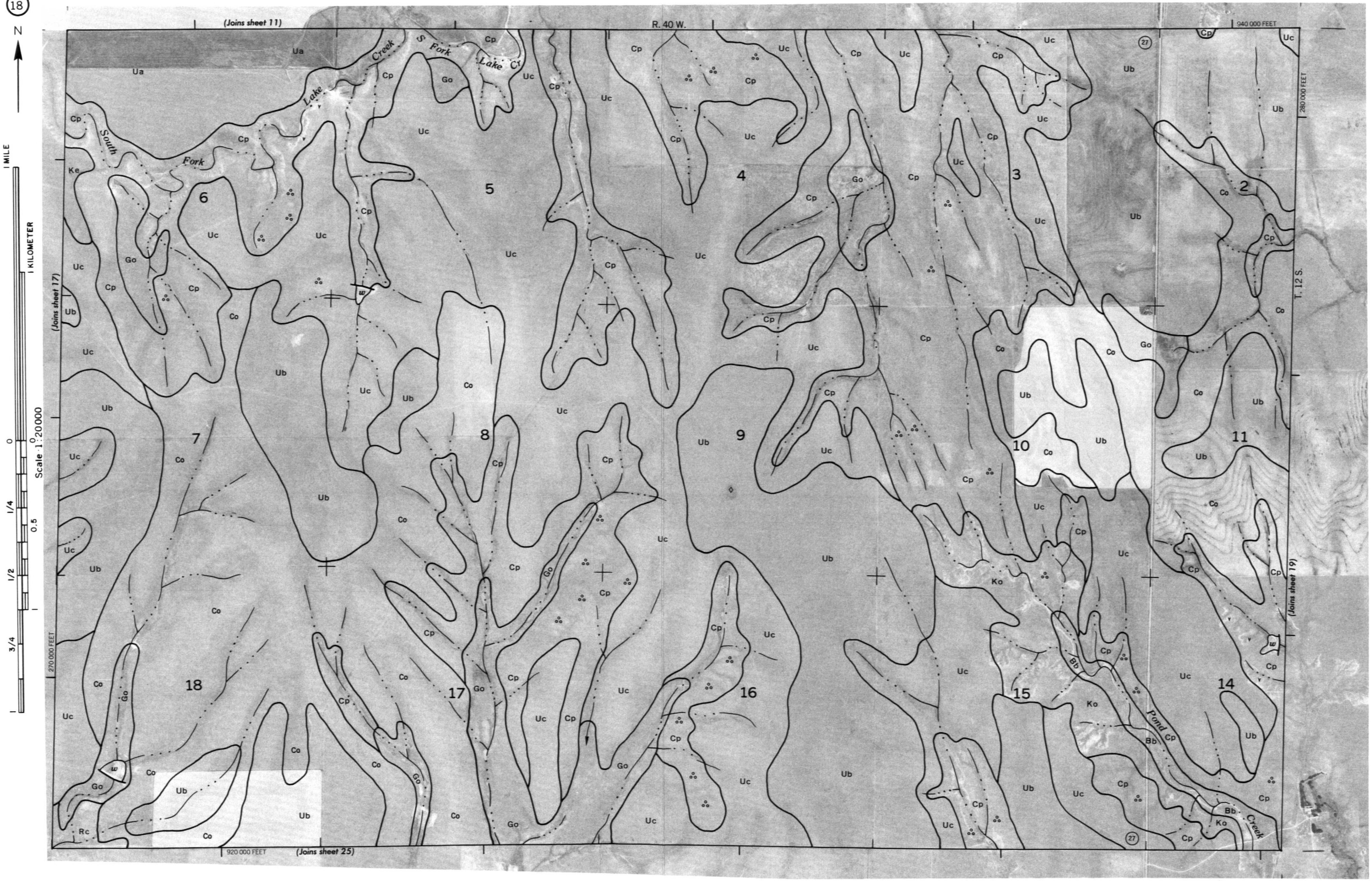
18

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 18



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WALLACE COUNTY, KANSAS NO. 18

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 19

19

WALLACE COUNTY, KANSAS NO. 19

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 20

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

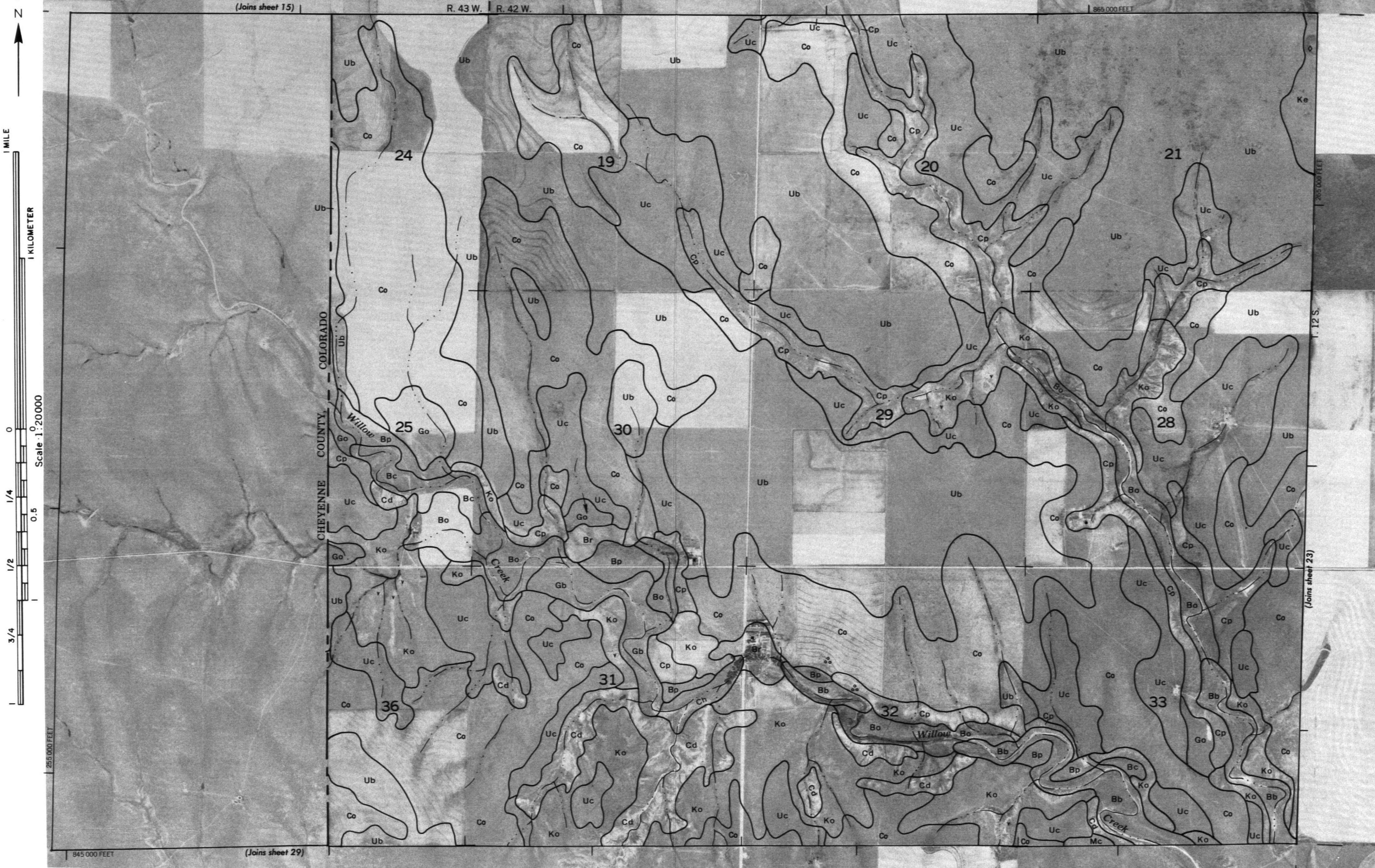
WALLACE COUNTY, KANSAS NO. 20

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 21

WALLACE COUNTY, KANSAS NO. 21

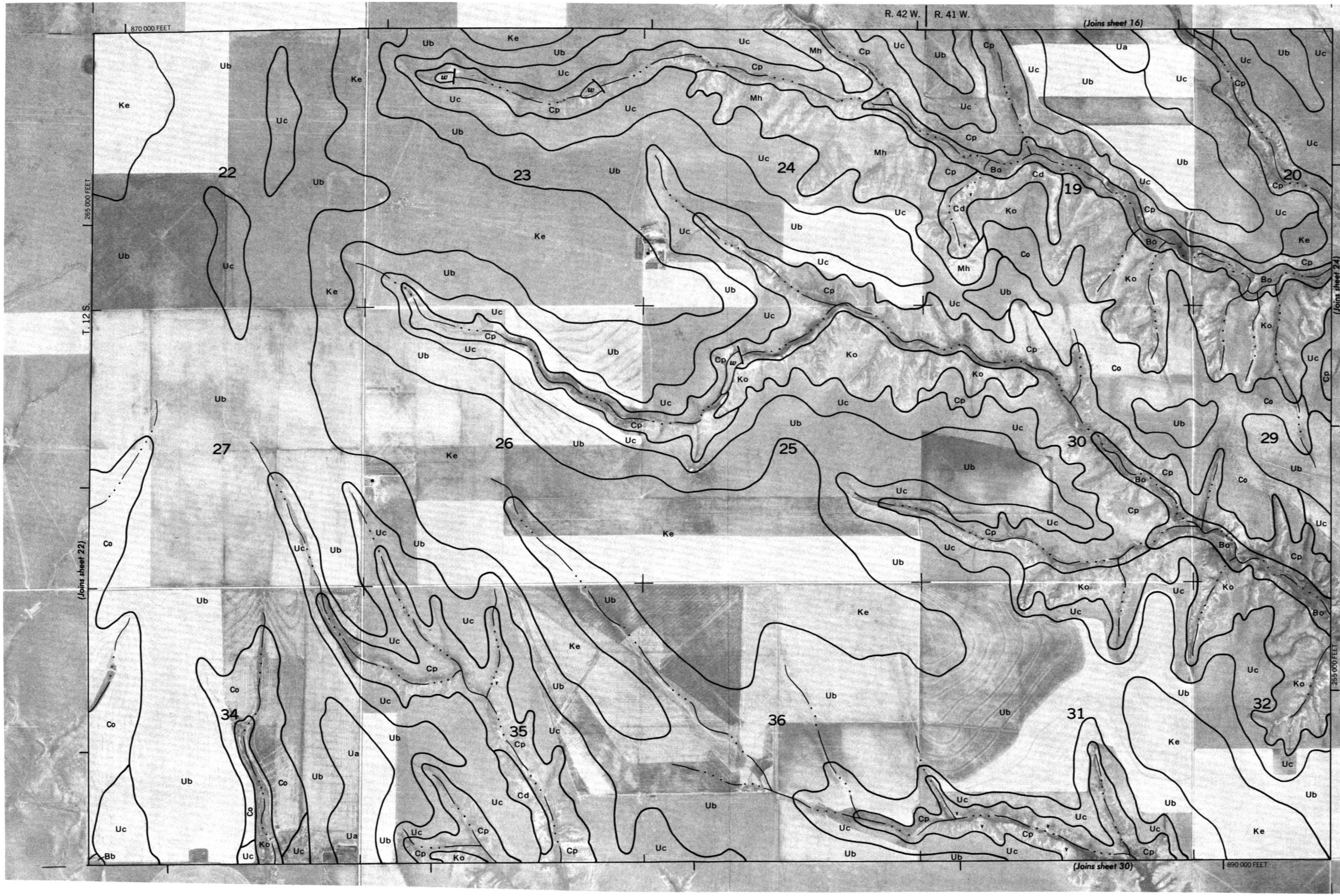
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 22



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 22



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

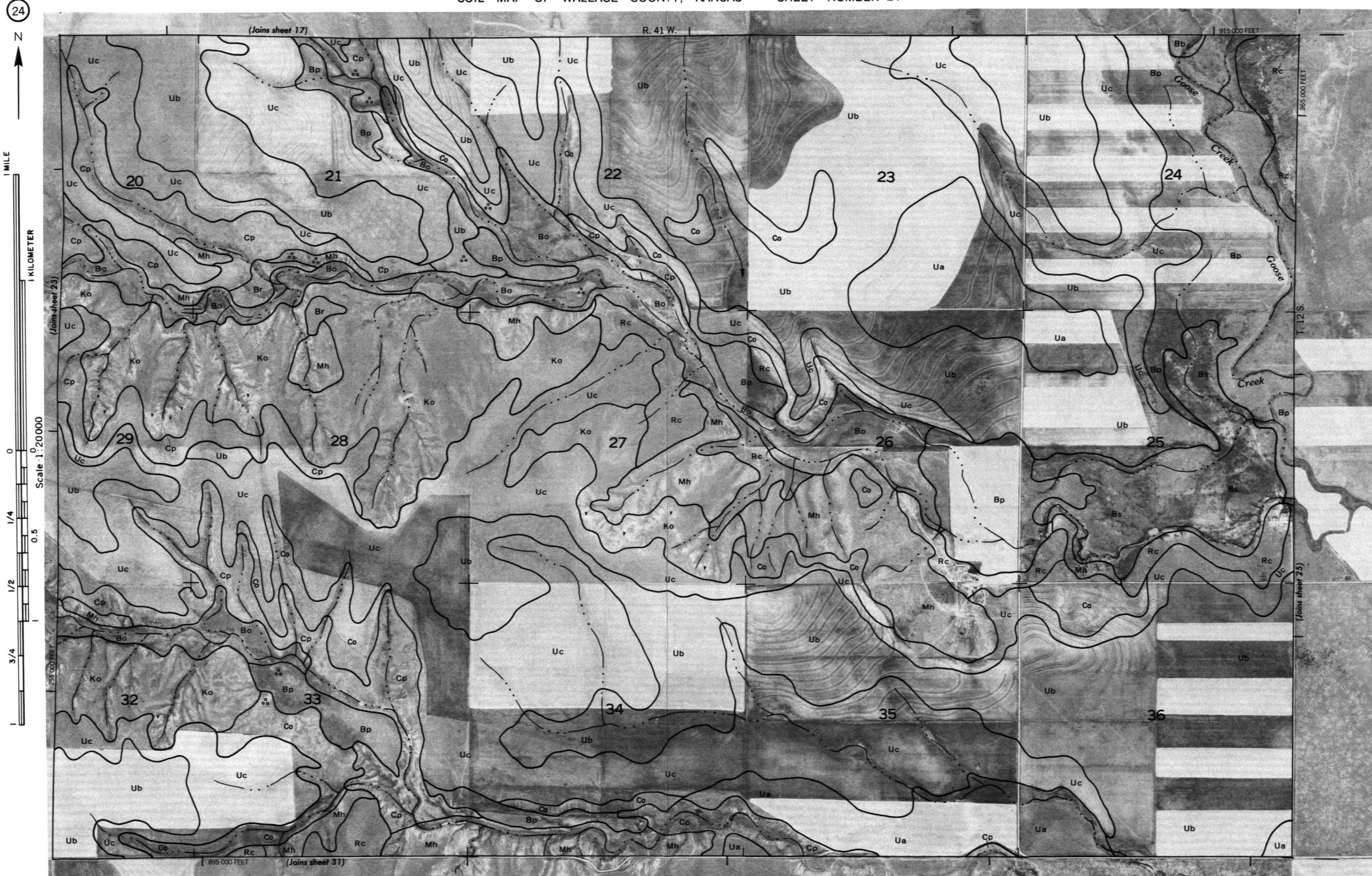
0 0.5 1

Scale 1:20000

WALLACE COUNTY, KANSAS NO. 23

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 24

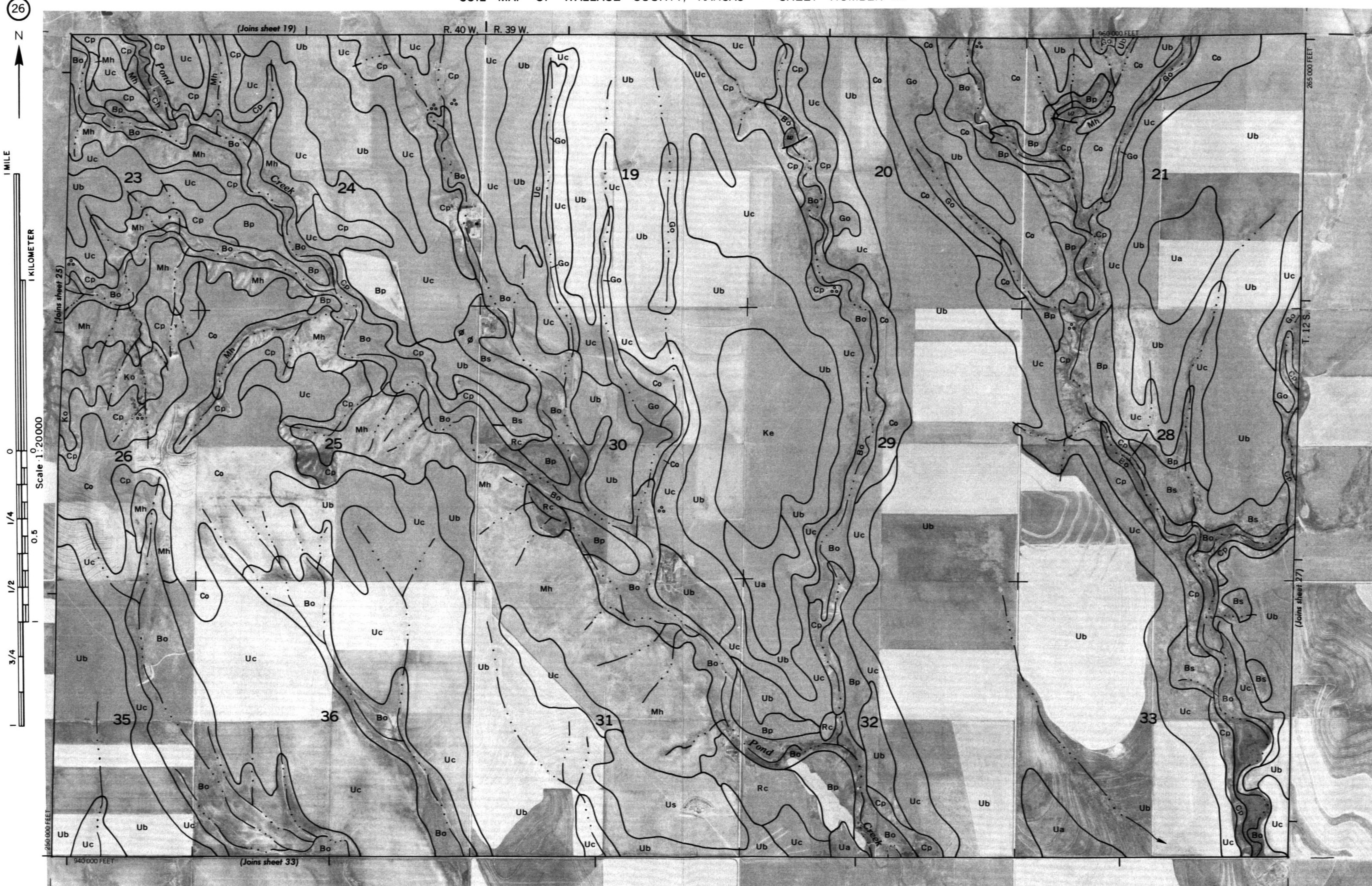


This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

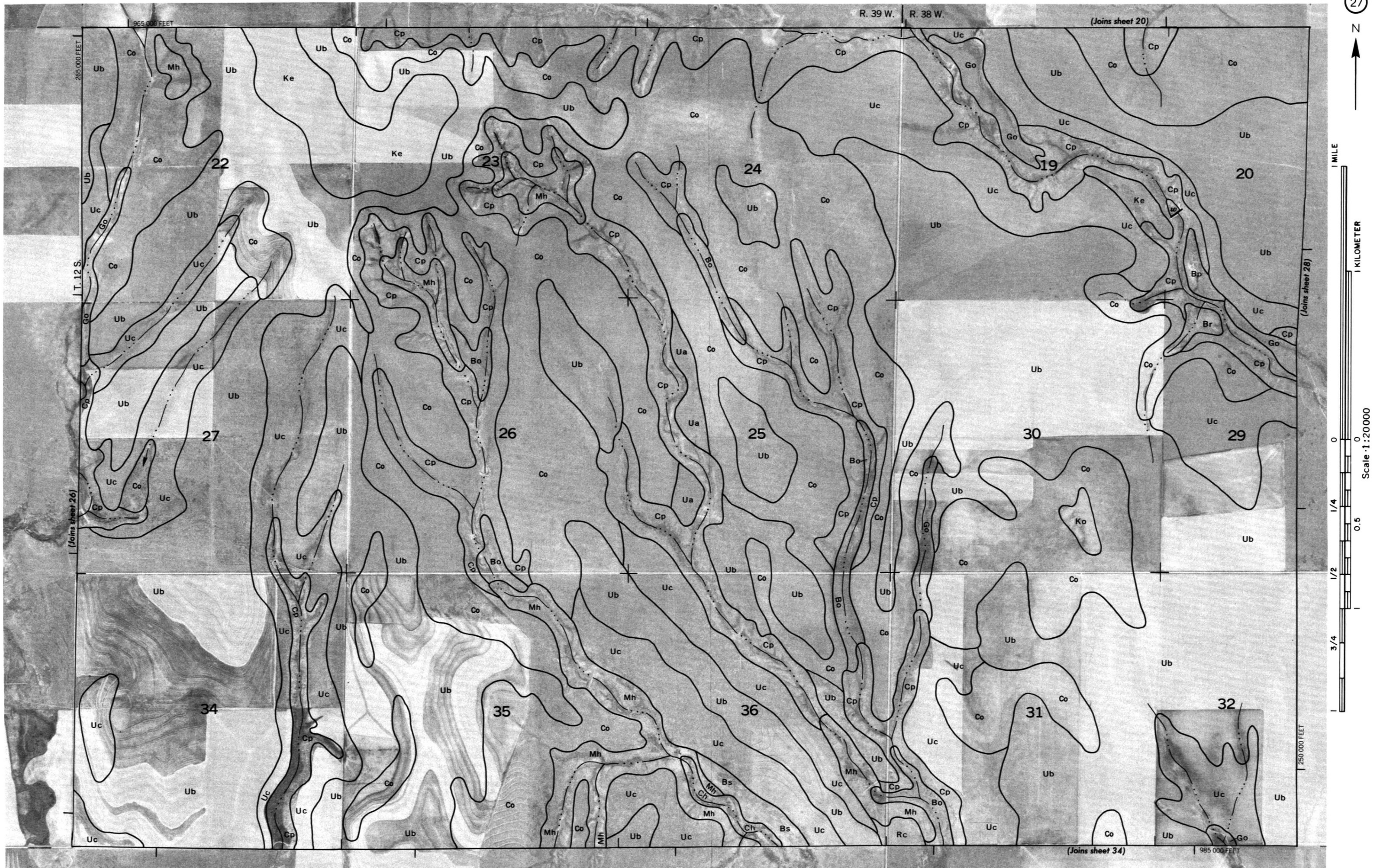
WALLACE COUNTY, KANSAS NO. 24

WALLACE COUNTY, KANSAS NO. 25

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



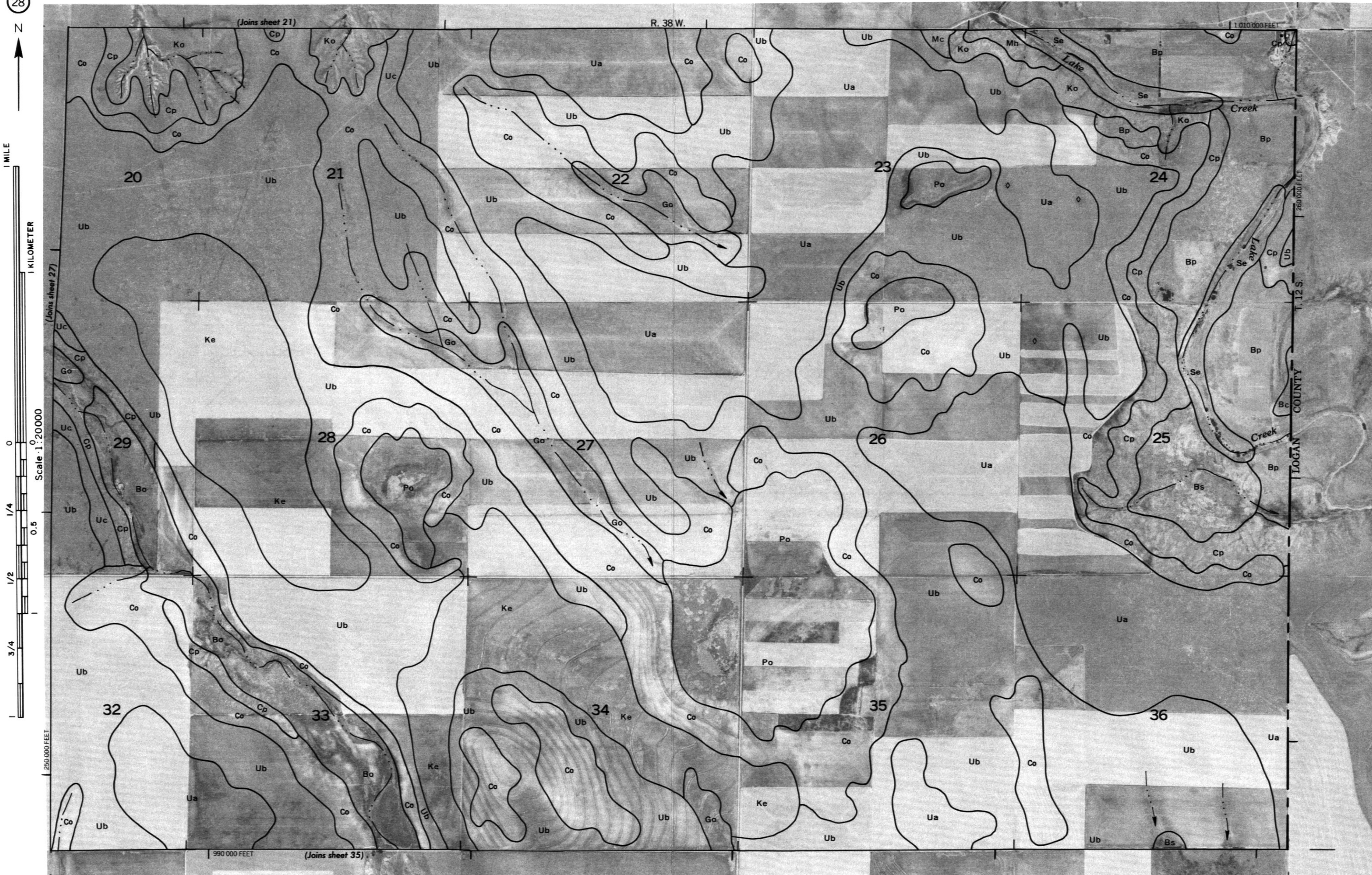
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WALLACE COUNTY, KANSAS NO. 27

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 28

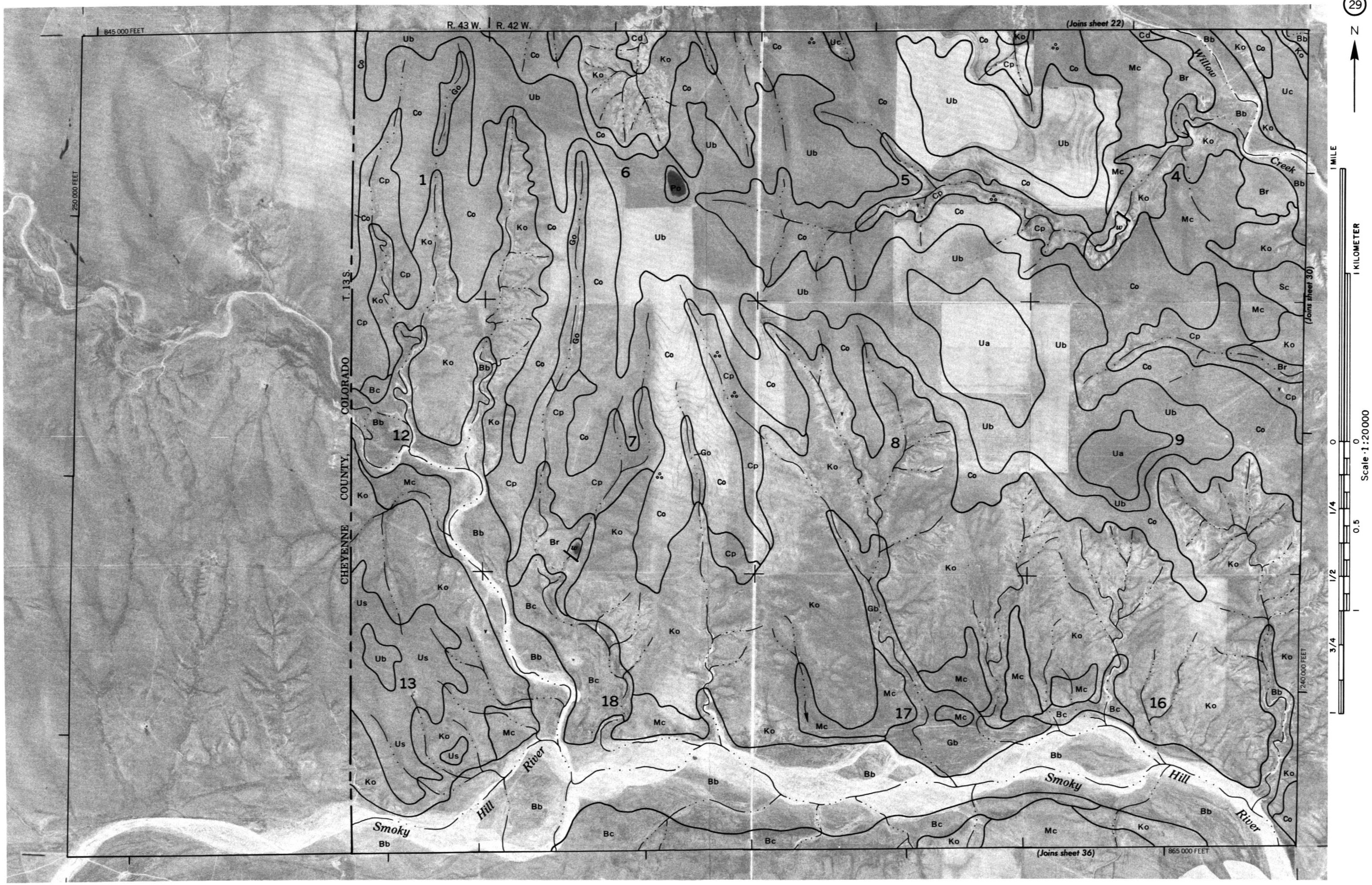


This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 29

WALLACE COUNTY, KANSAS NO. 29

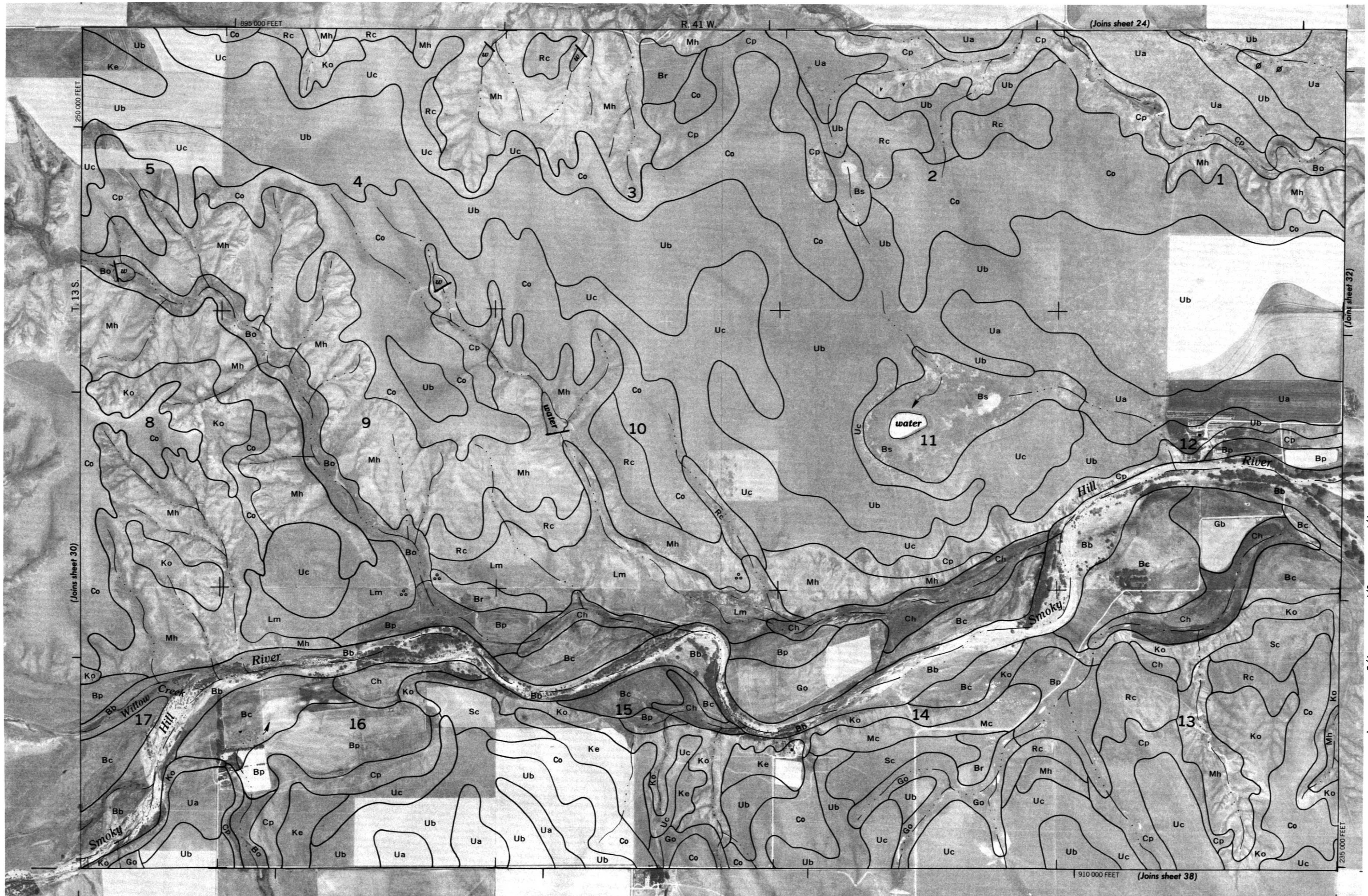
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 30

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 31



WALLACE COUNTY, KANSAS NO. 31

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

31

N

1 MILE

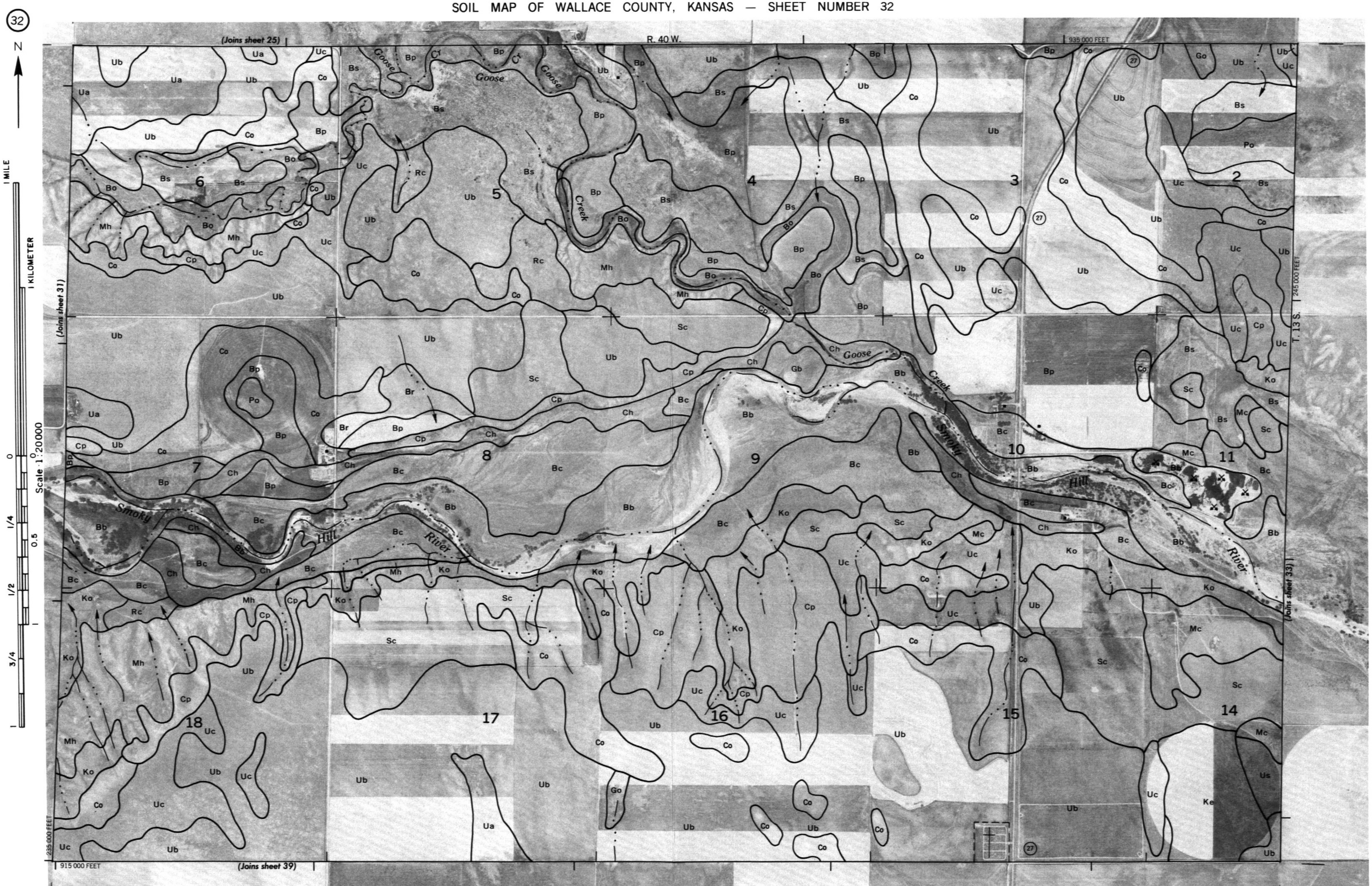
1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 32



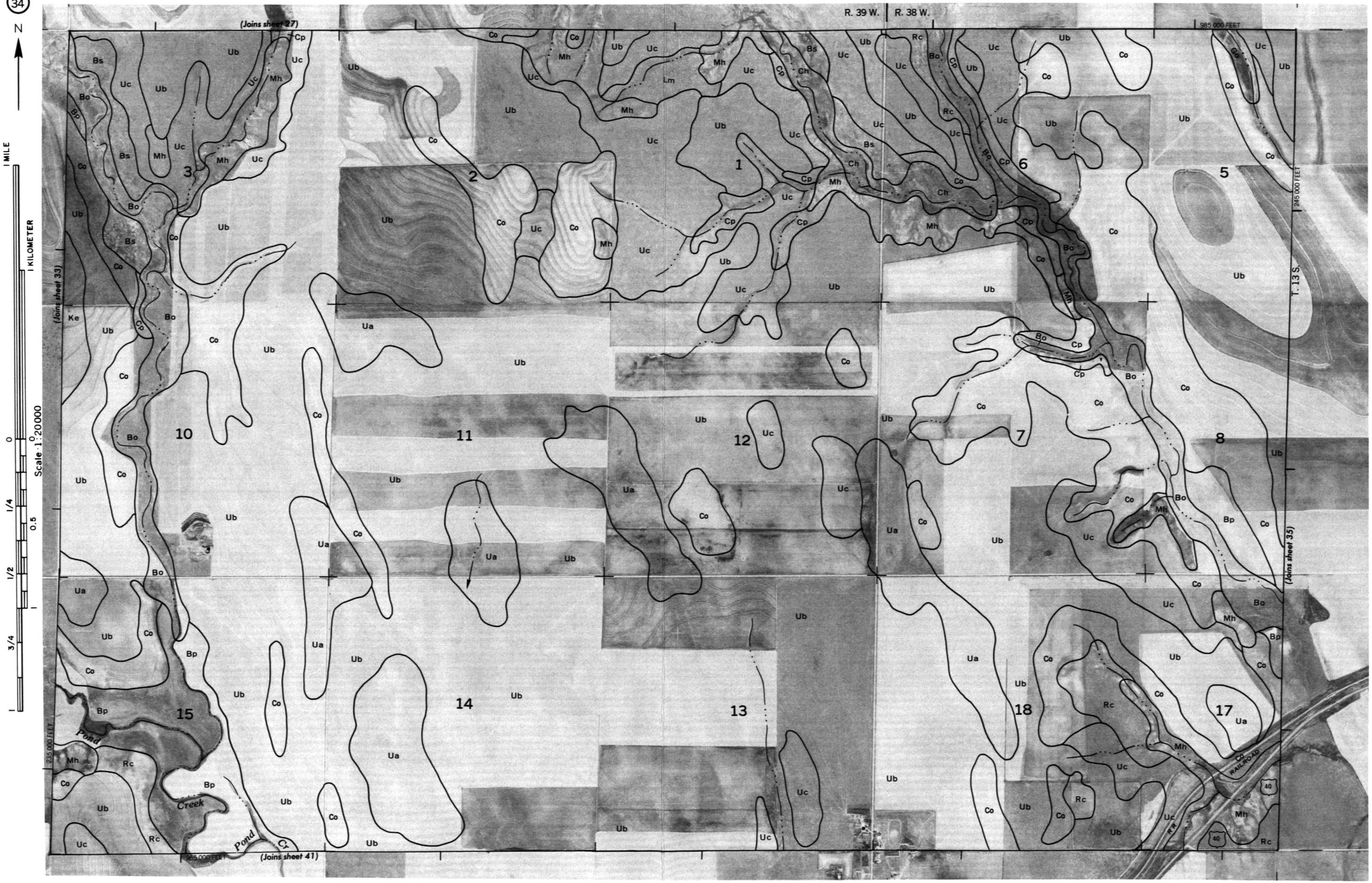
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 32

WALLACE COUNTY, KANSAS NO. 33

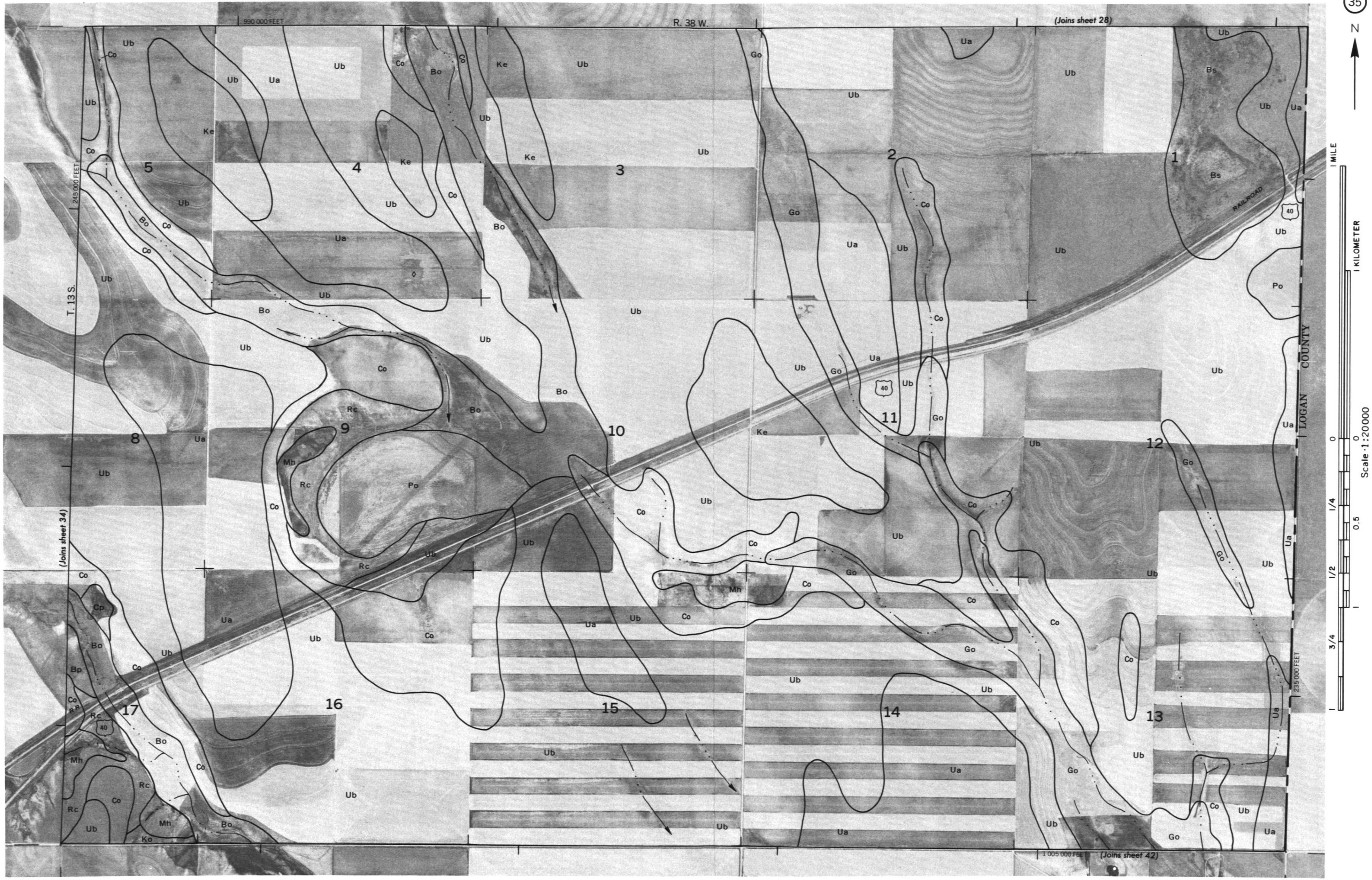
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 34



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

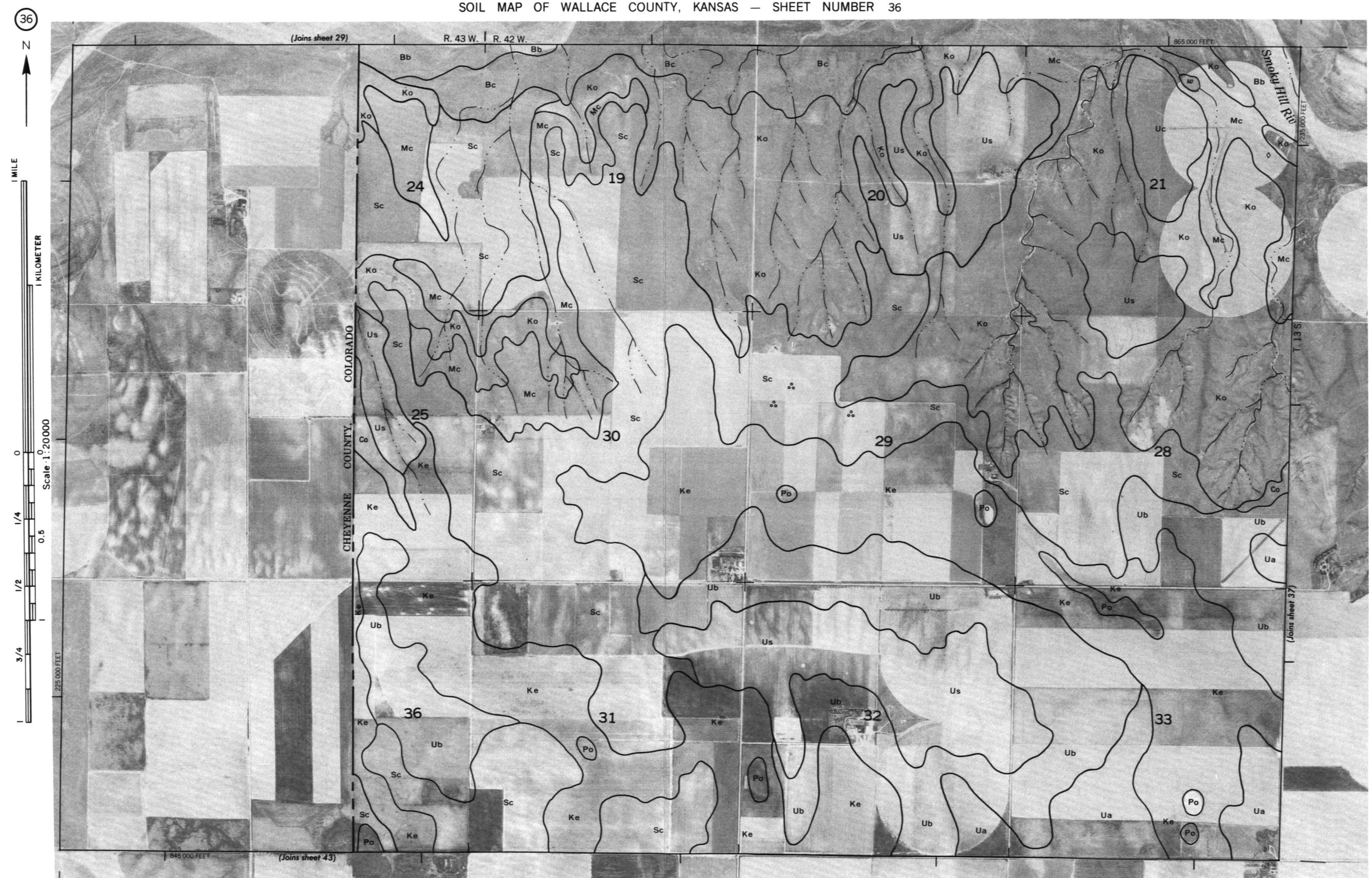
WALLACE COUNTY, KANSAS NO. 34



WALLACE COUNTY, KANSAS NO. 35

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 36



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 36

WALLACE COUNTY, KANSAS NO. 37

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 38

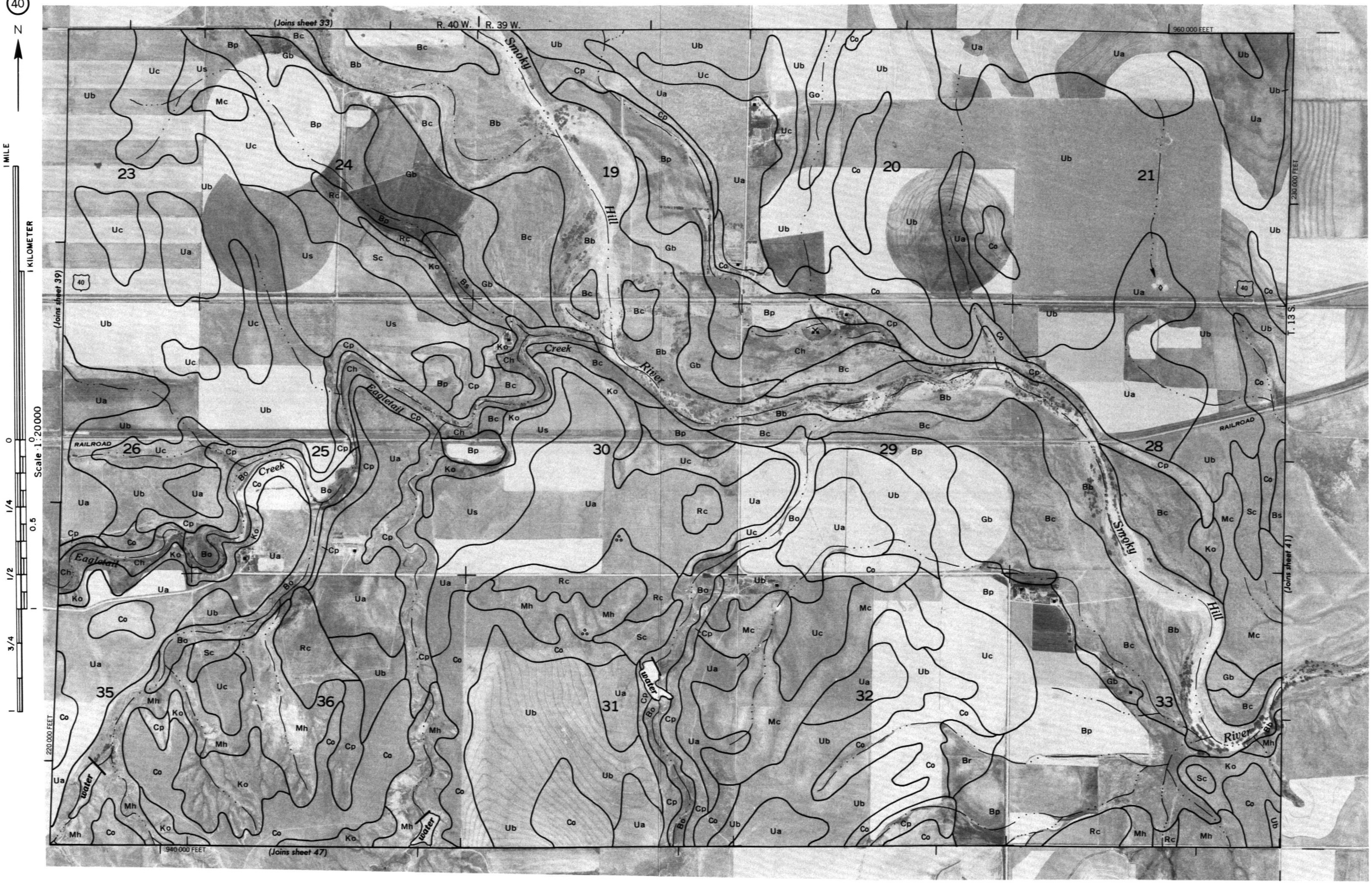
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 39

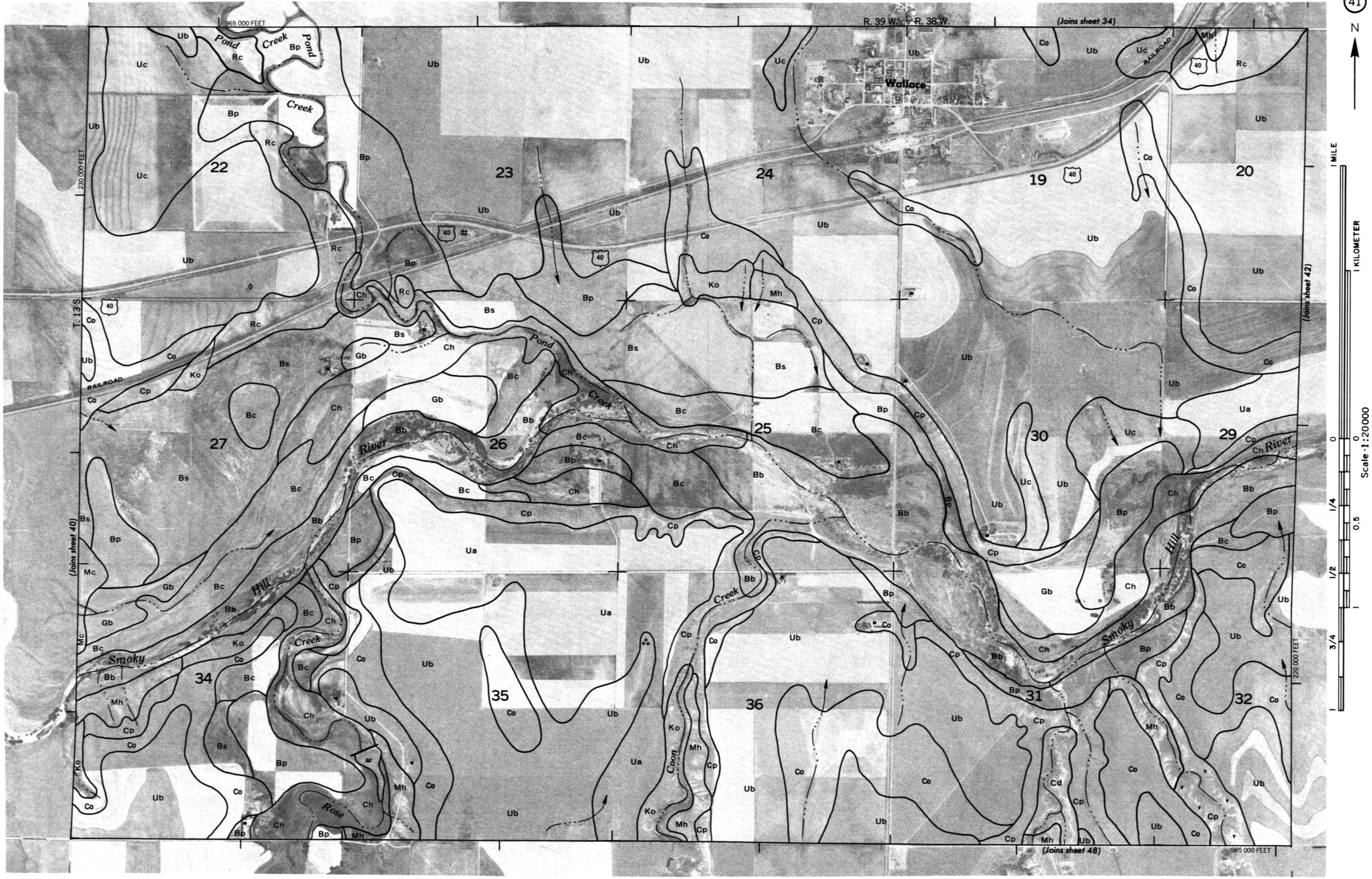
WALLACE COUNTY, KANSAS NO. 39

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 40



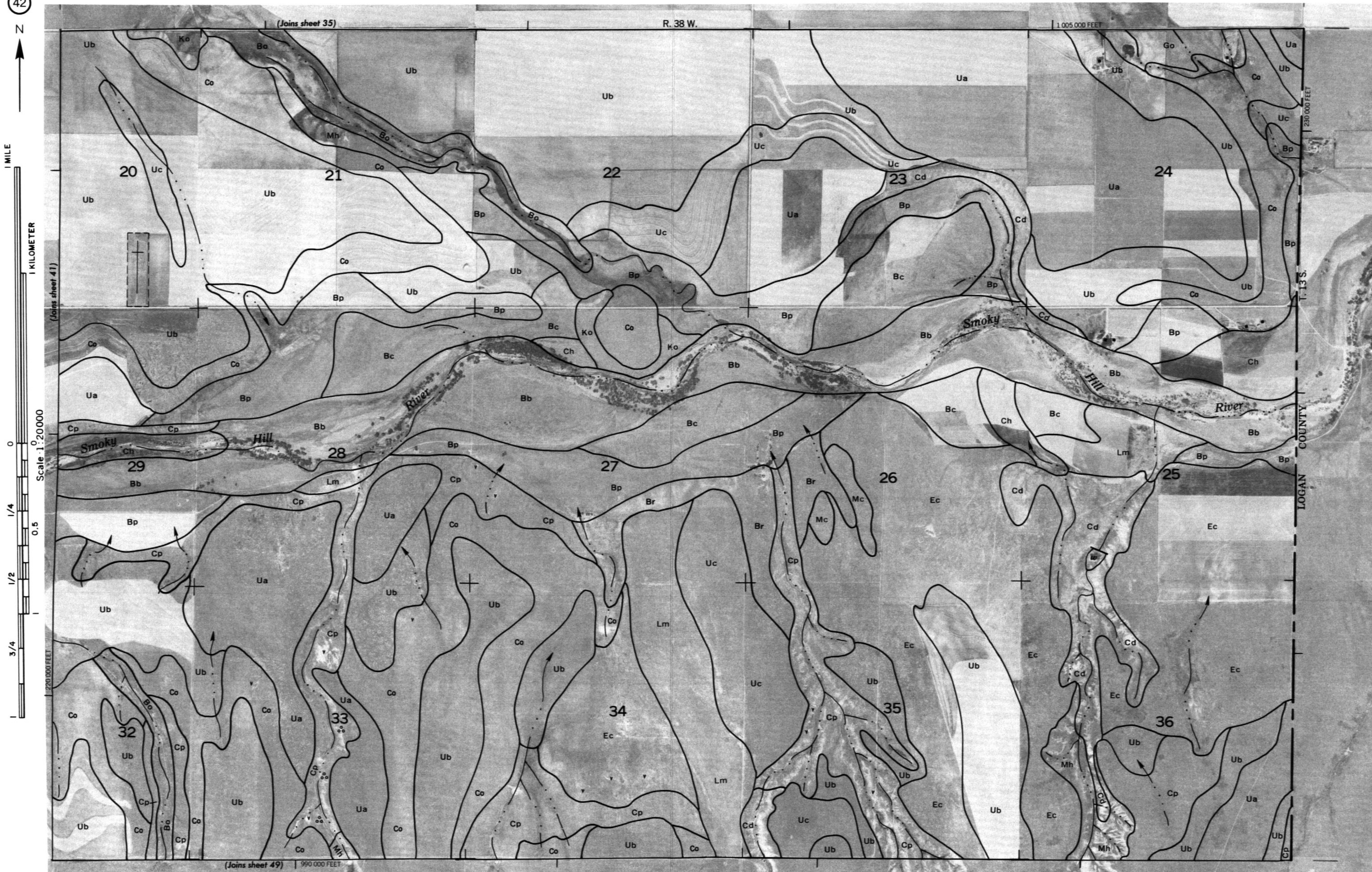
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WALLACE COUNTY, KANSAS NO. 41

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 42



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

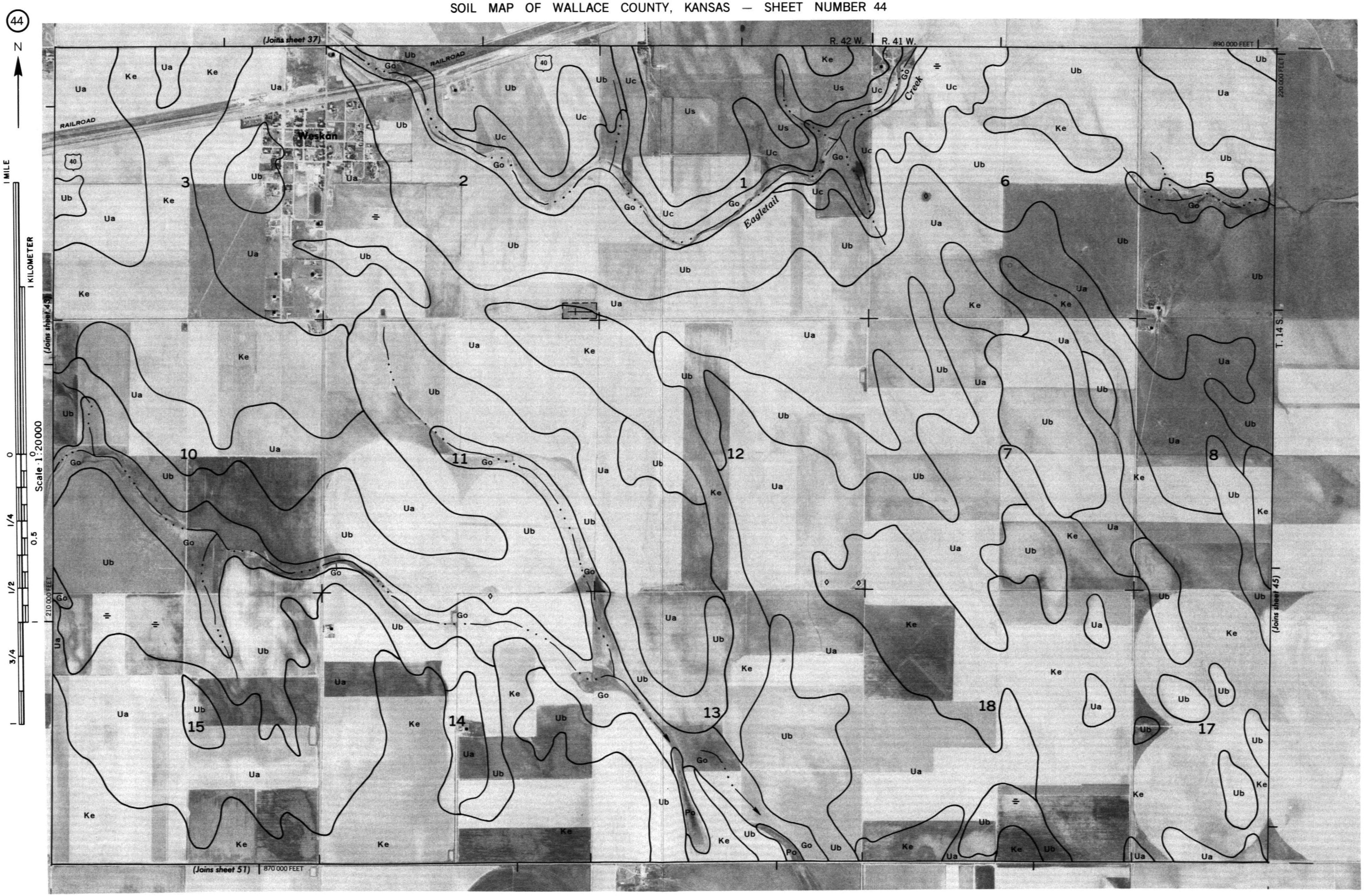
WALLACE COUNTY, KANSAS NO. 42

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 43

WALLACE COUNTY, KANSAS NO. 43

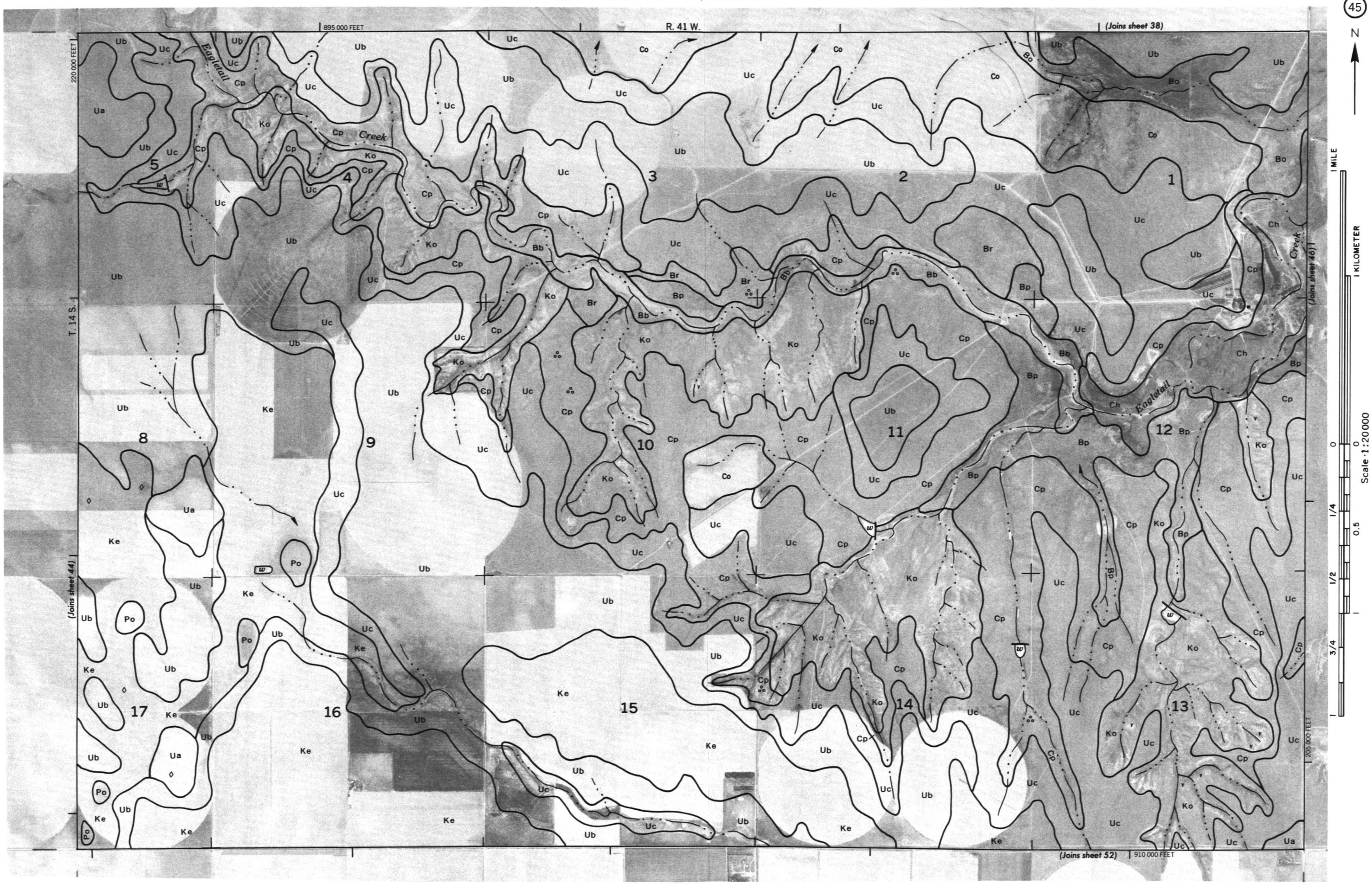
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 44



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 44

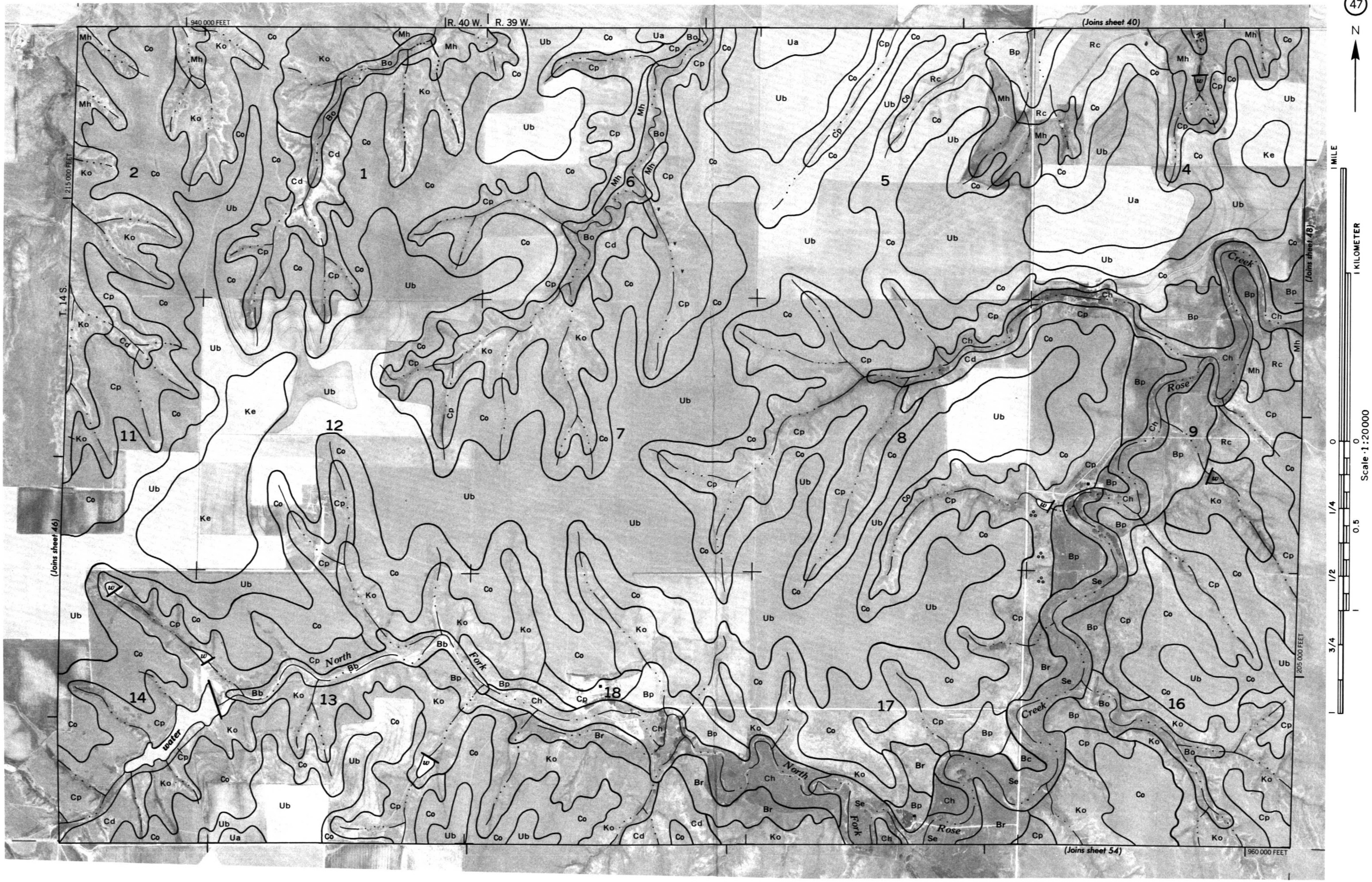


WALLACE COUNTY, KANSAS NO. 45

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 46

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WALLACE COUNTY, KANSAS NO. 47

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 48

48

N

1 MILE

1 KILOMETER

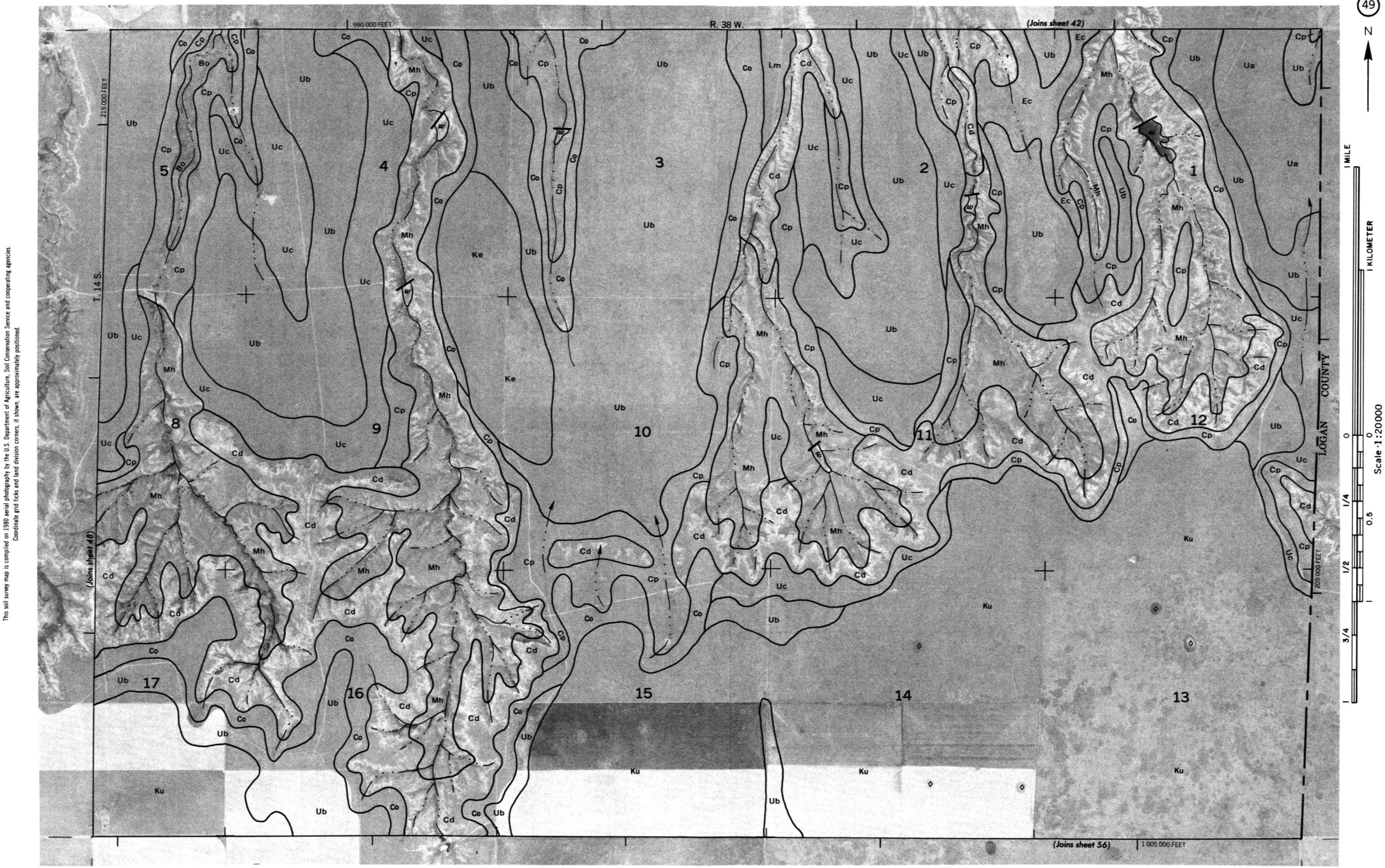
Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

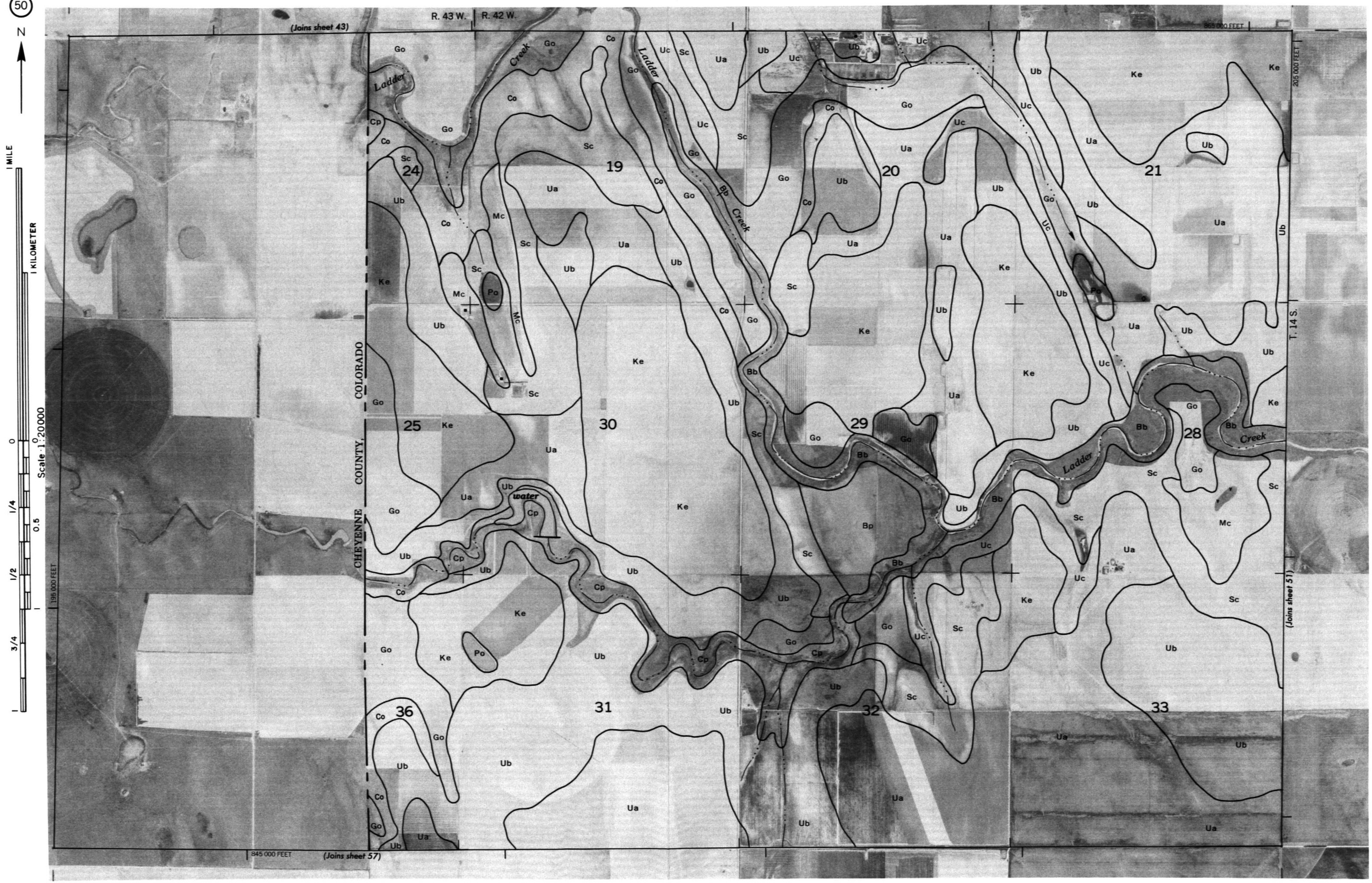
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 48


49
N
990 000 FEET
R. 38 W.
(Joins sheet 42)
215 000 FEET
T. 14 S.
(Joins sheet 48)
LOGAN COUNTY
205 000 FEET
(Joins sheet 56)
1 005 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5
WALLACE COUNTY, KANSAS NO. 49
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(50)

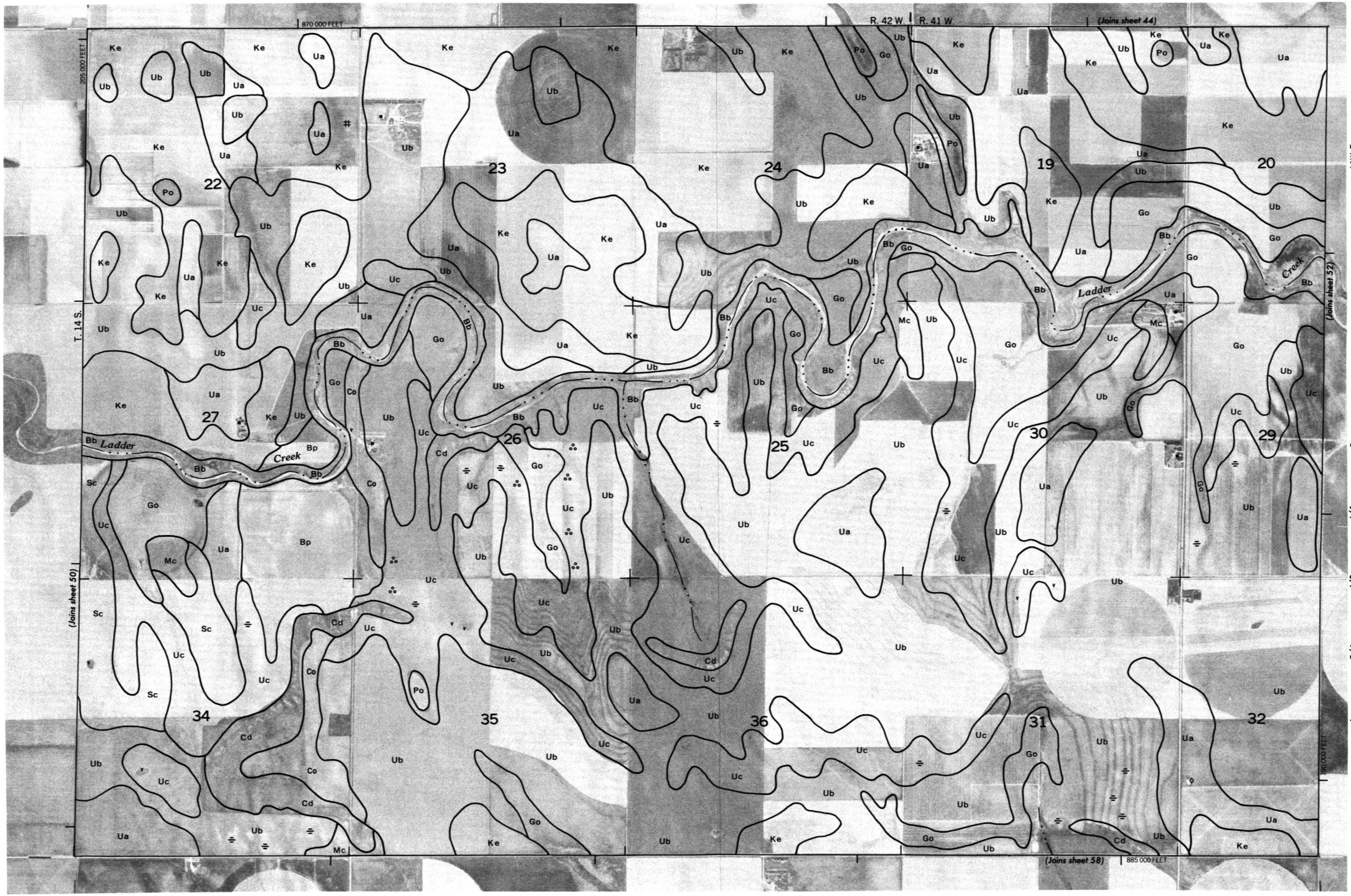
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 50



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 50

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 51



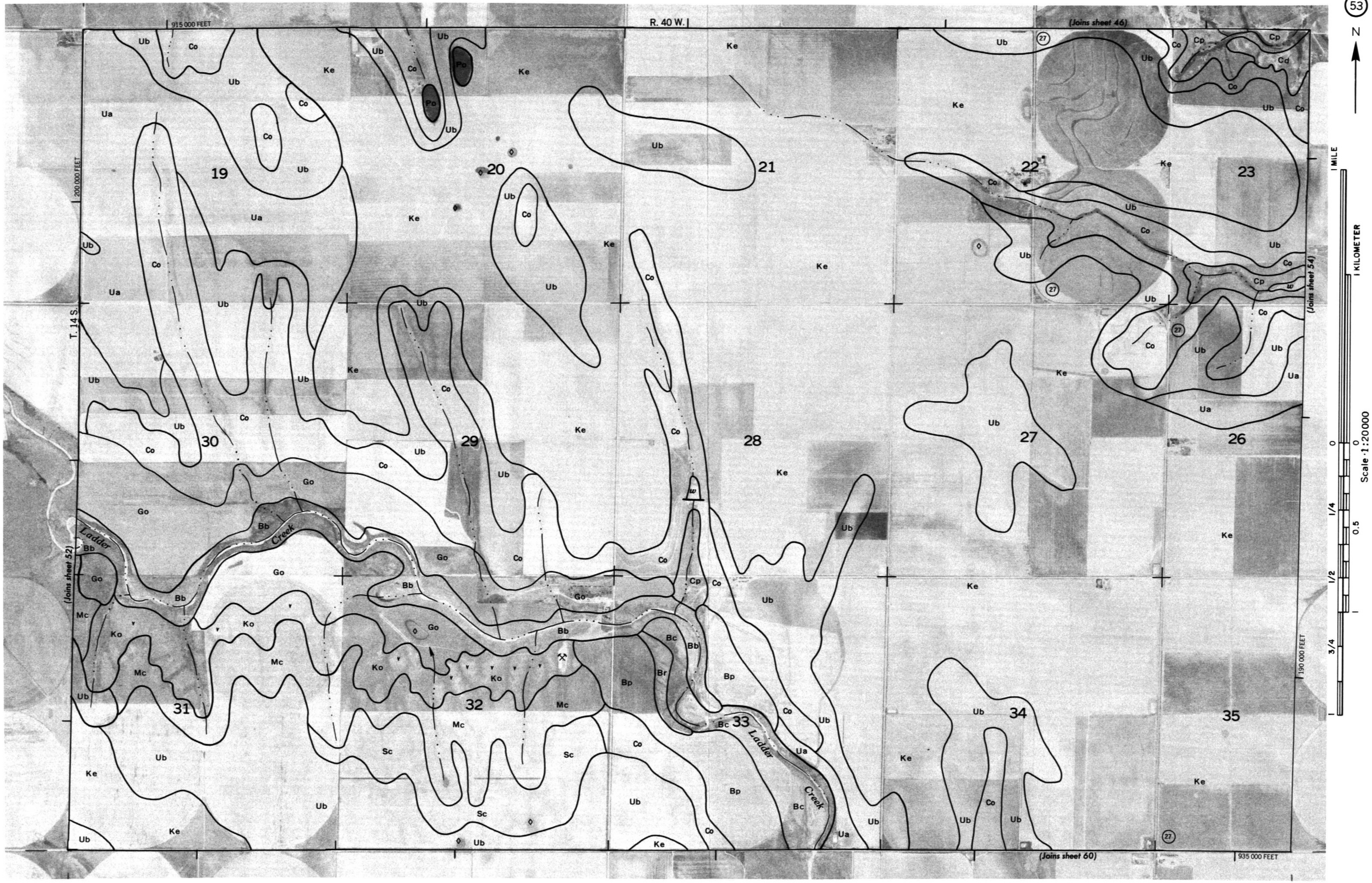
WALLACE COUNTY, KANSAS NO. 51

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 52

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

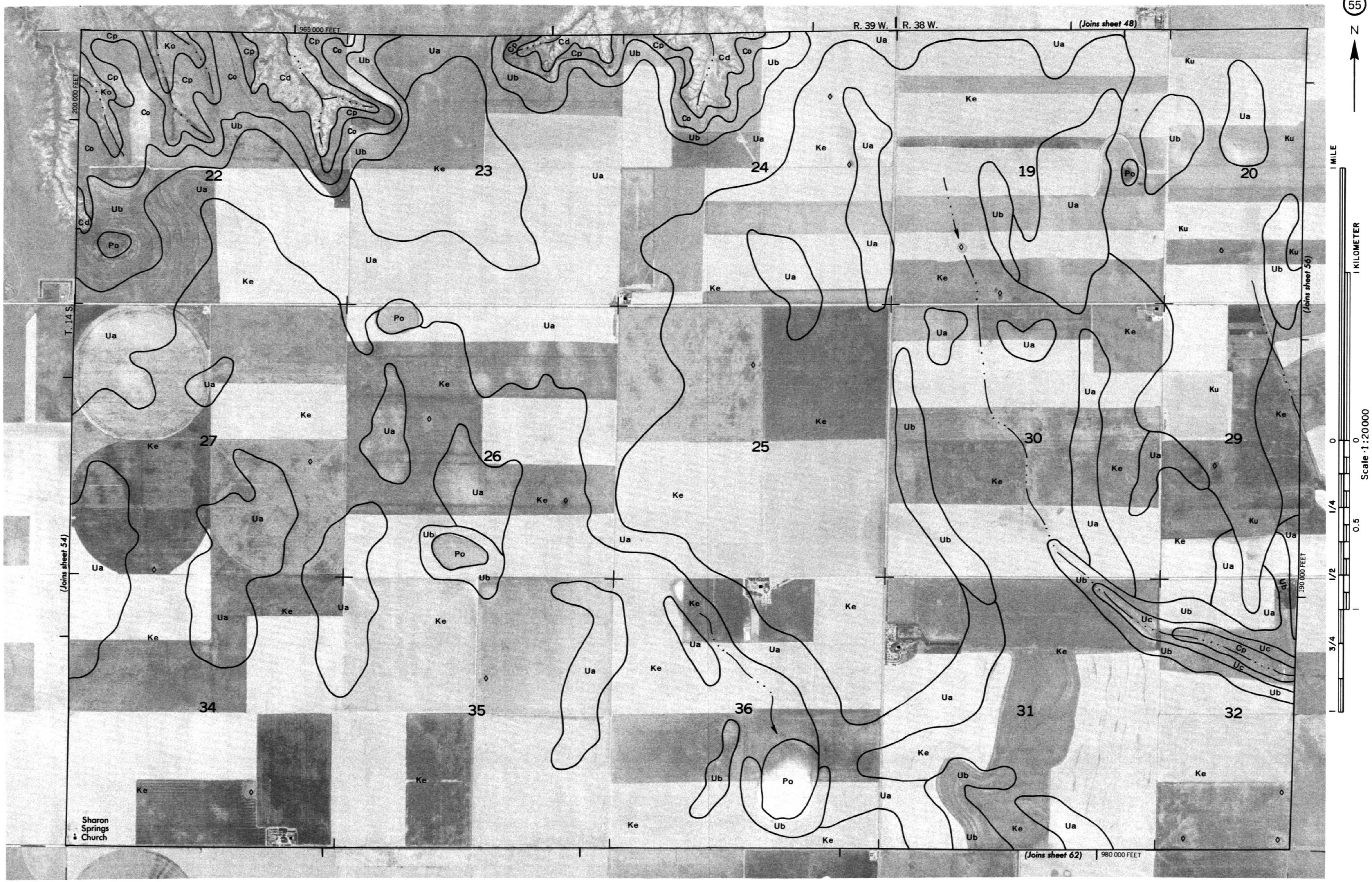
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 54

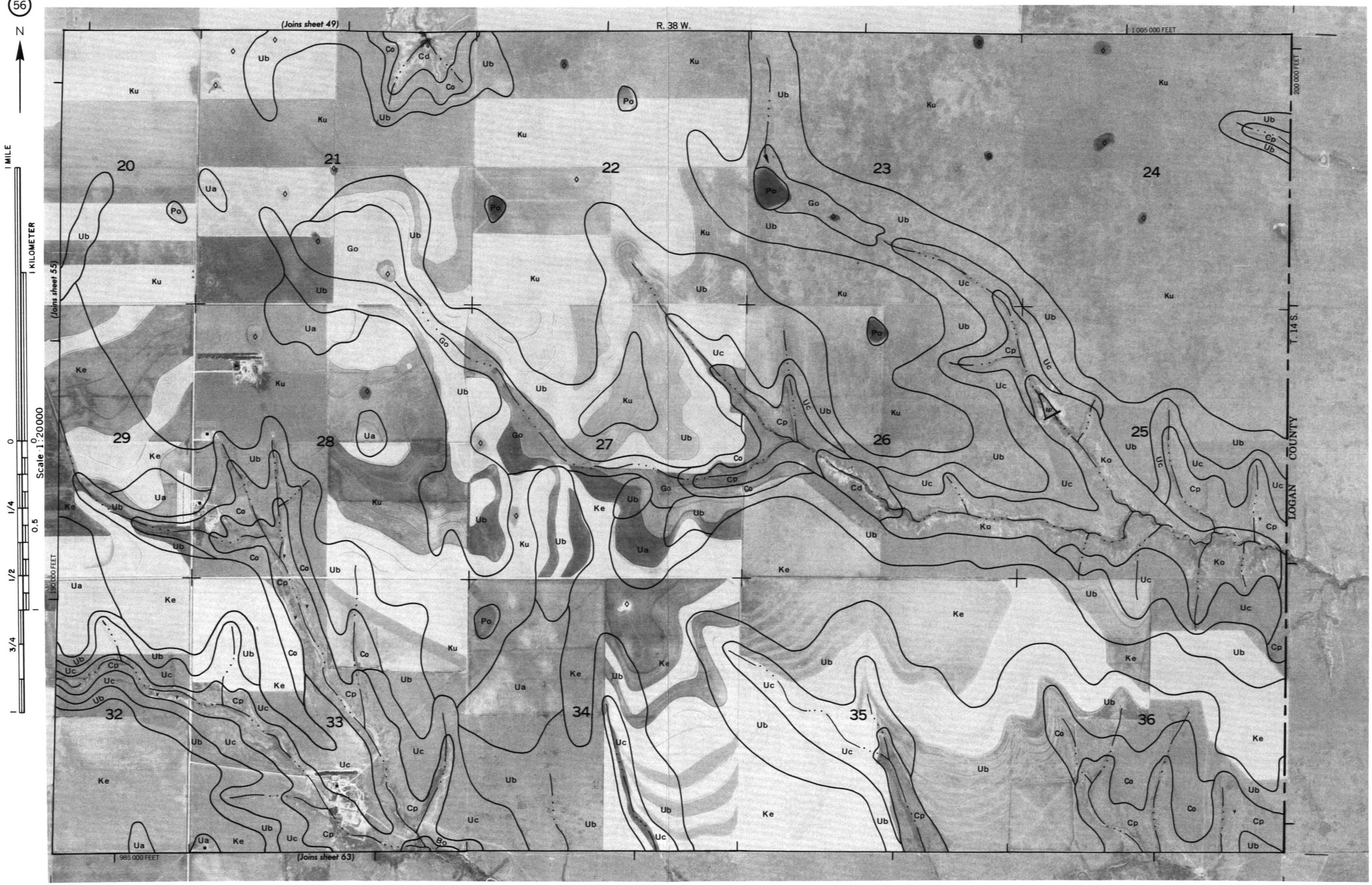
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

WALLACE COUNTY, KANSAS NO. 54



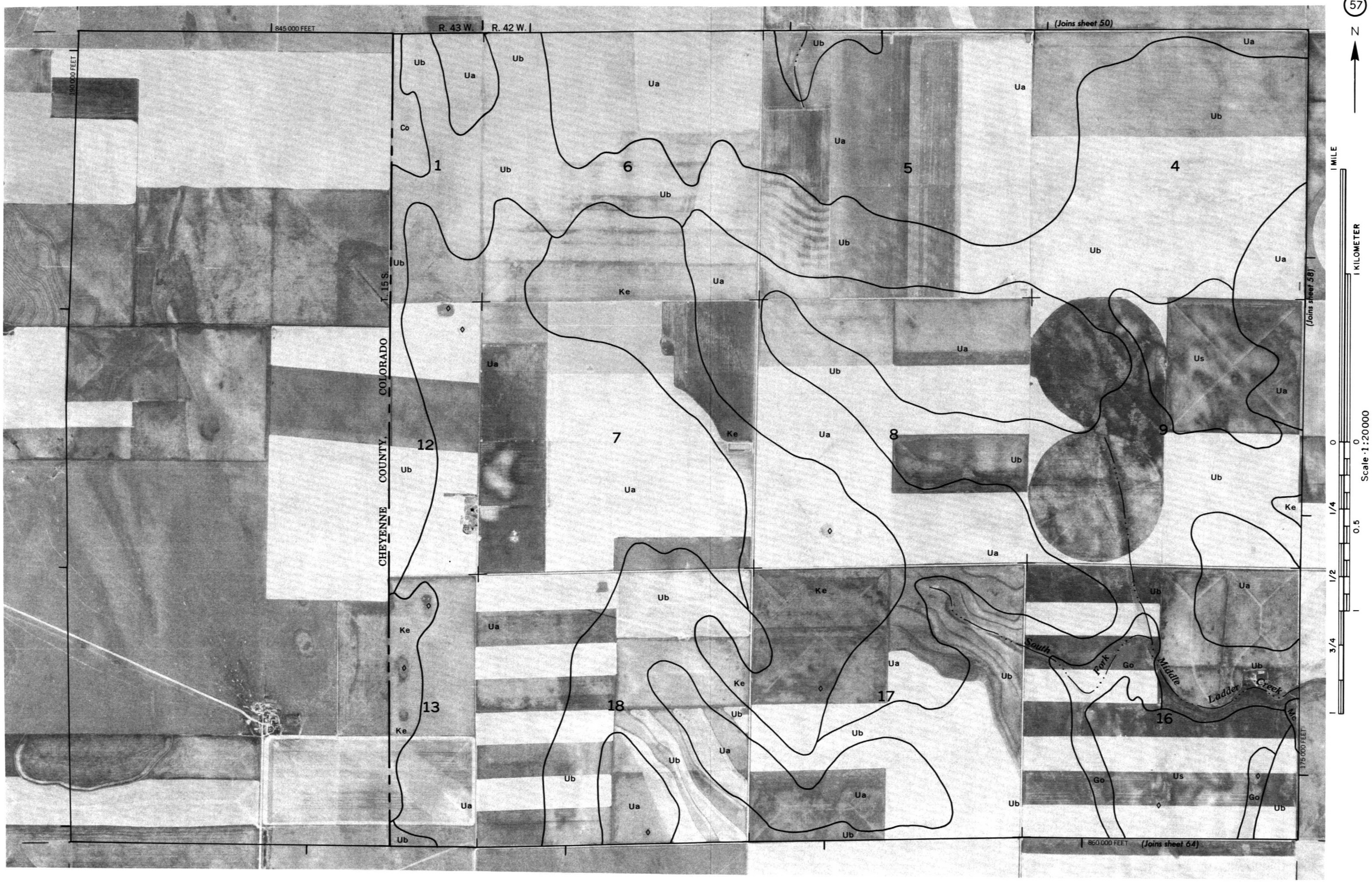
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 56



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

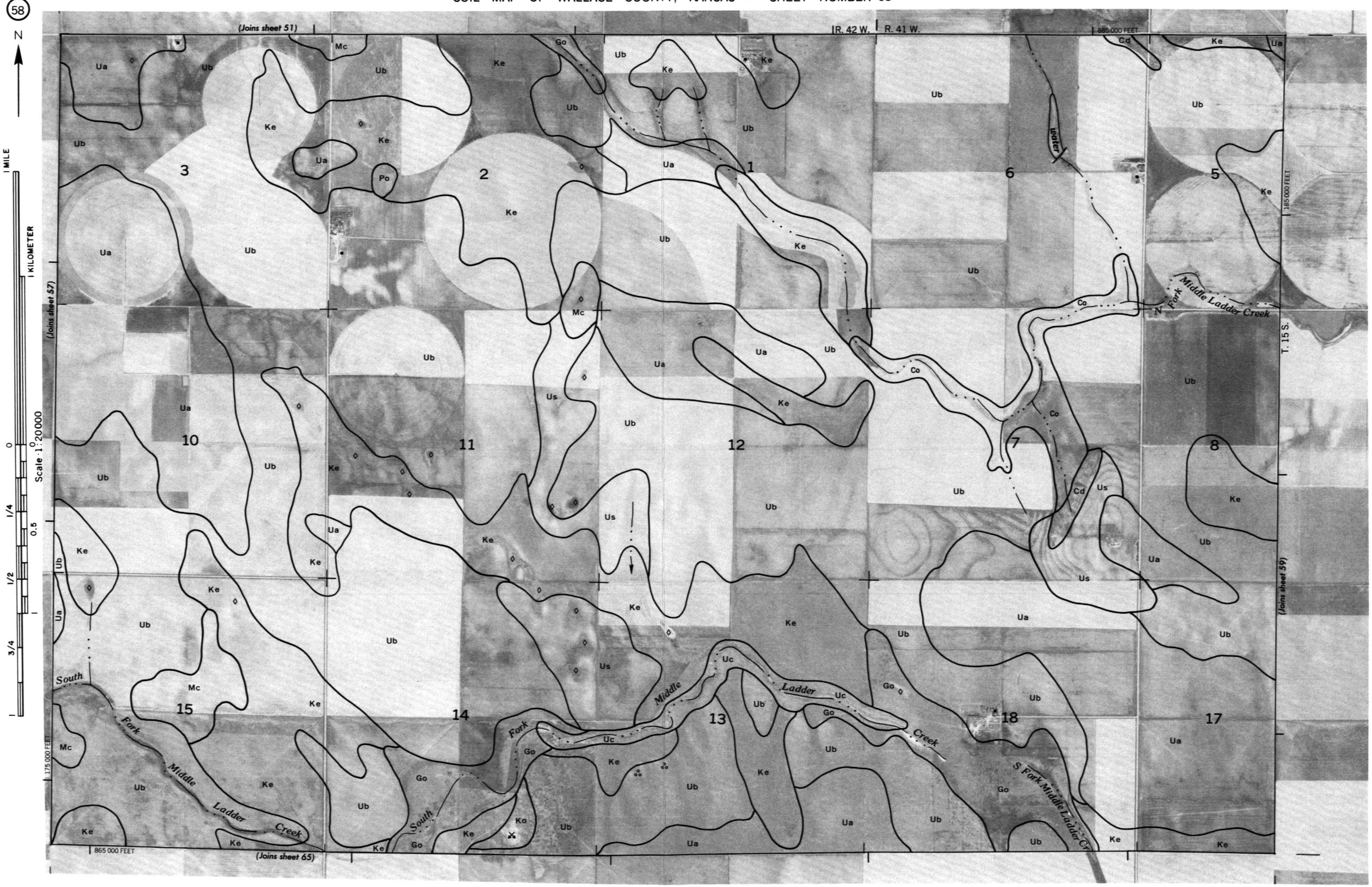
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 57



WALLACE COUNTY, KANSAS NO. 57

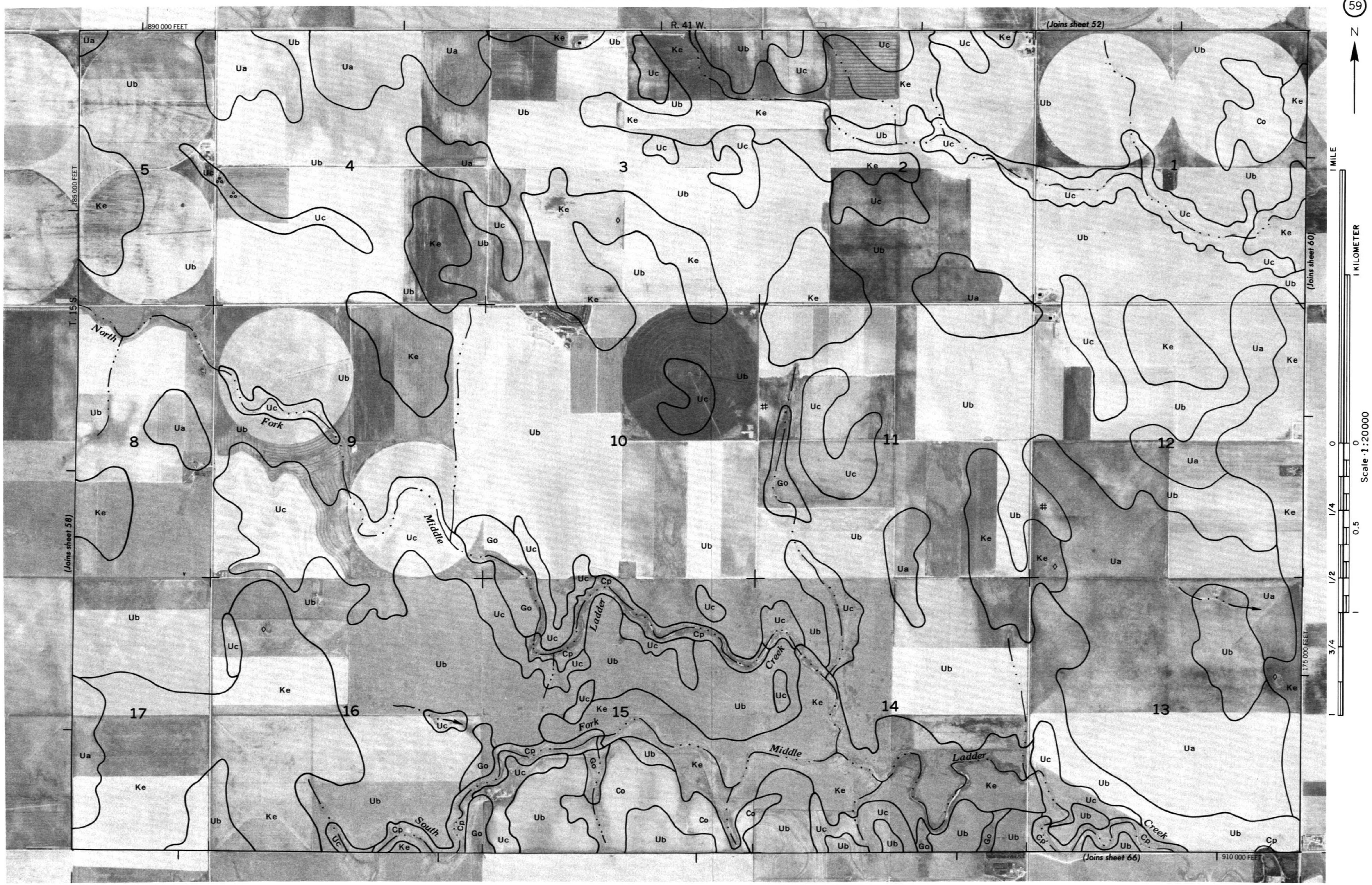
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 58



WALLACE COUNTY, KANSAS NO. 58

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WALLACE COUNTY, KANSAS NO. 59

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 60

N

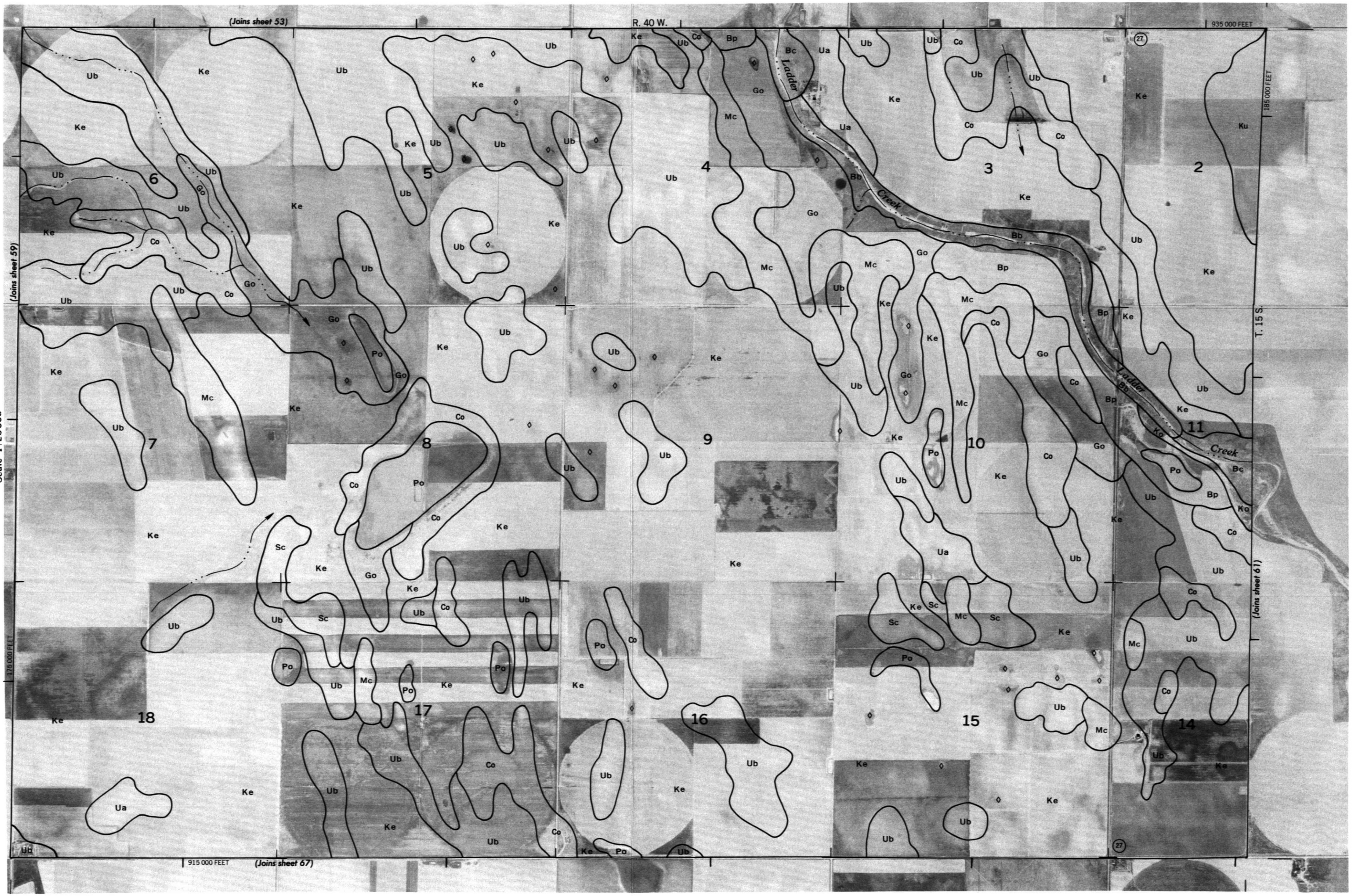
1 MILE

1 KILOMETER

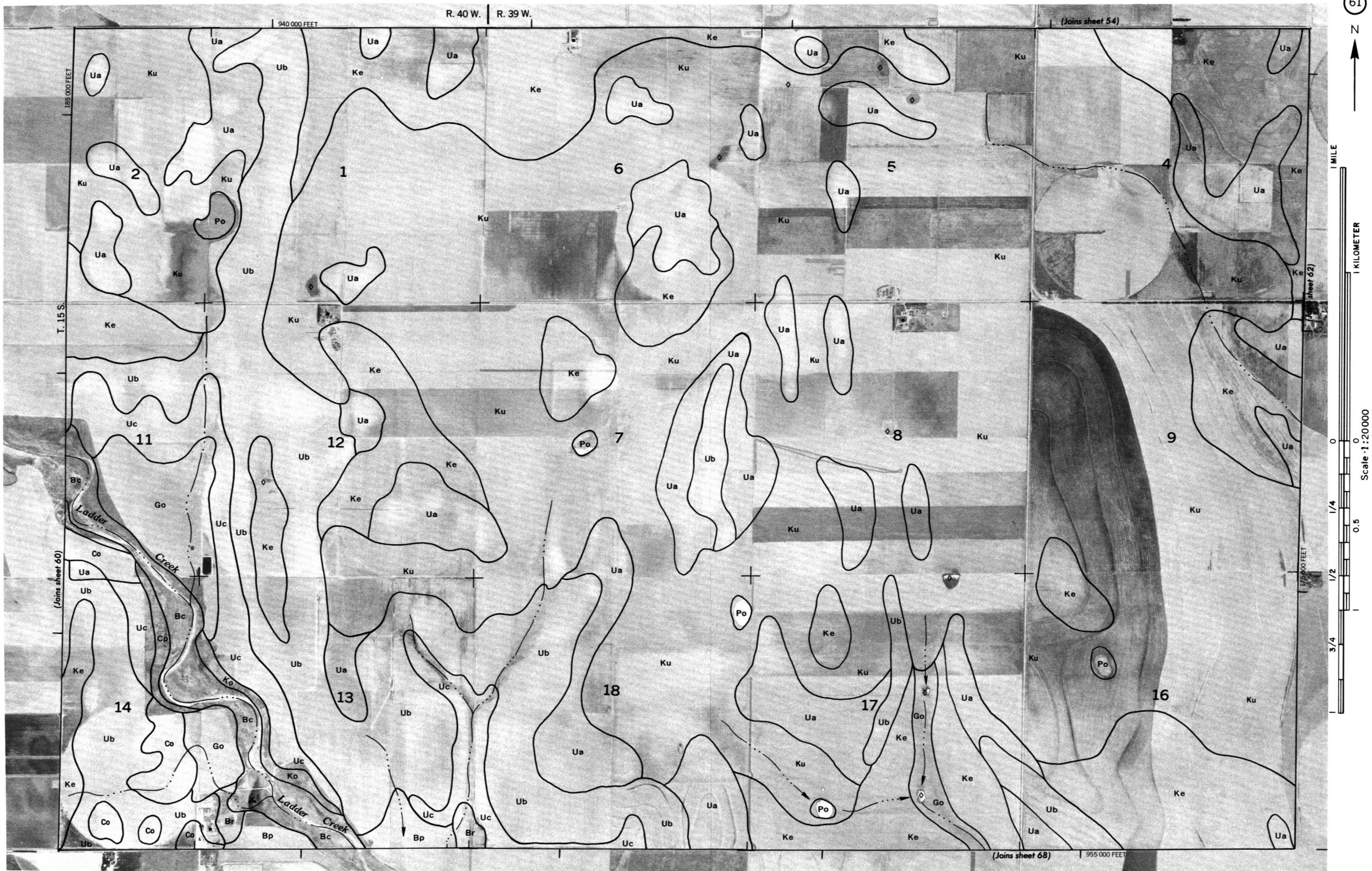
Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

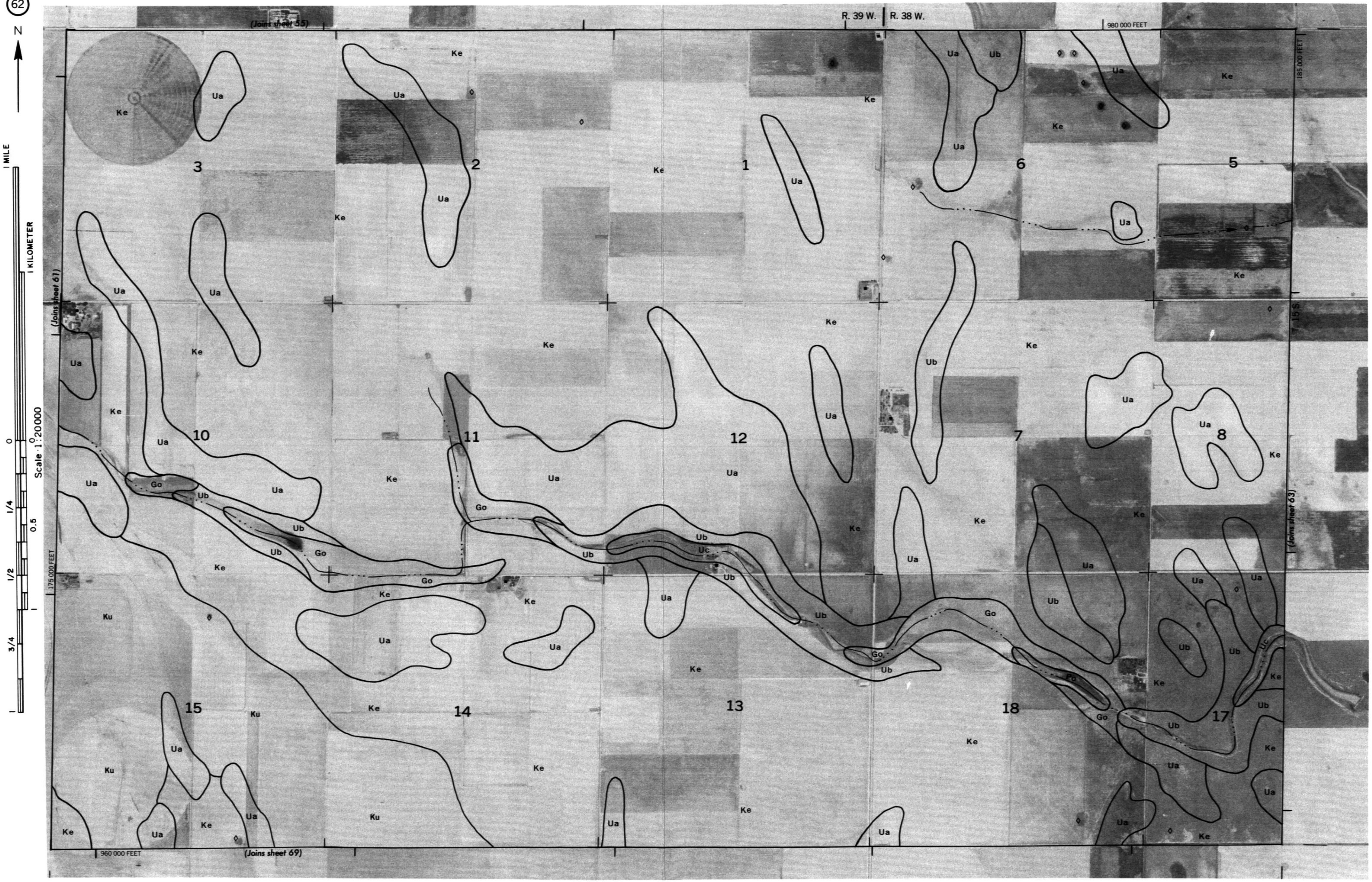


This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



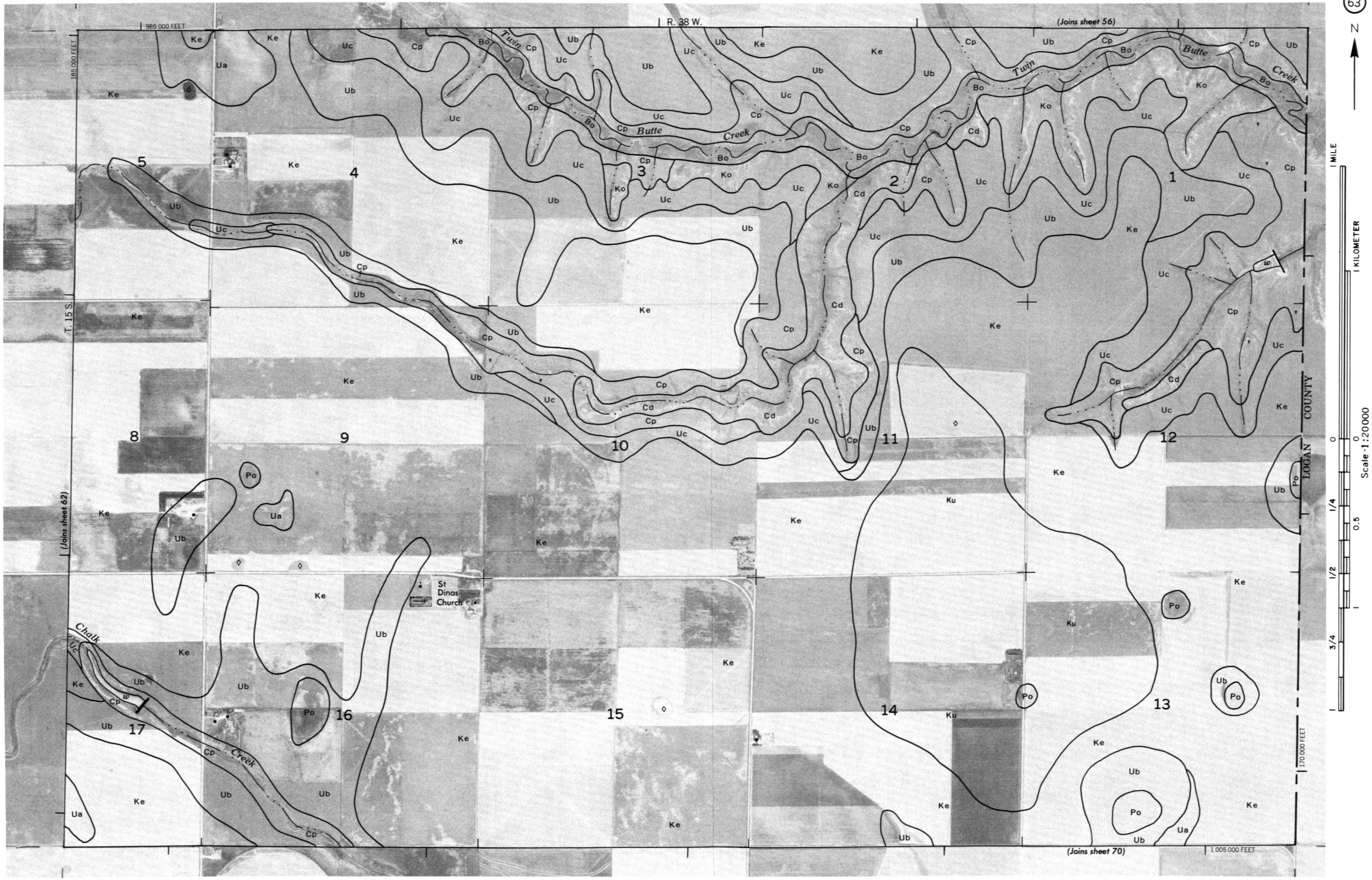
This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 62



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

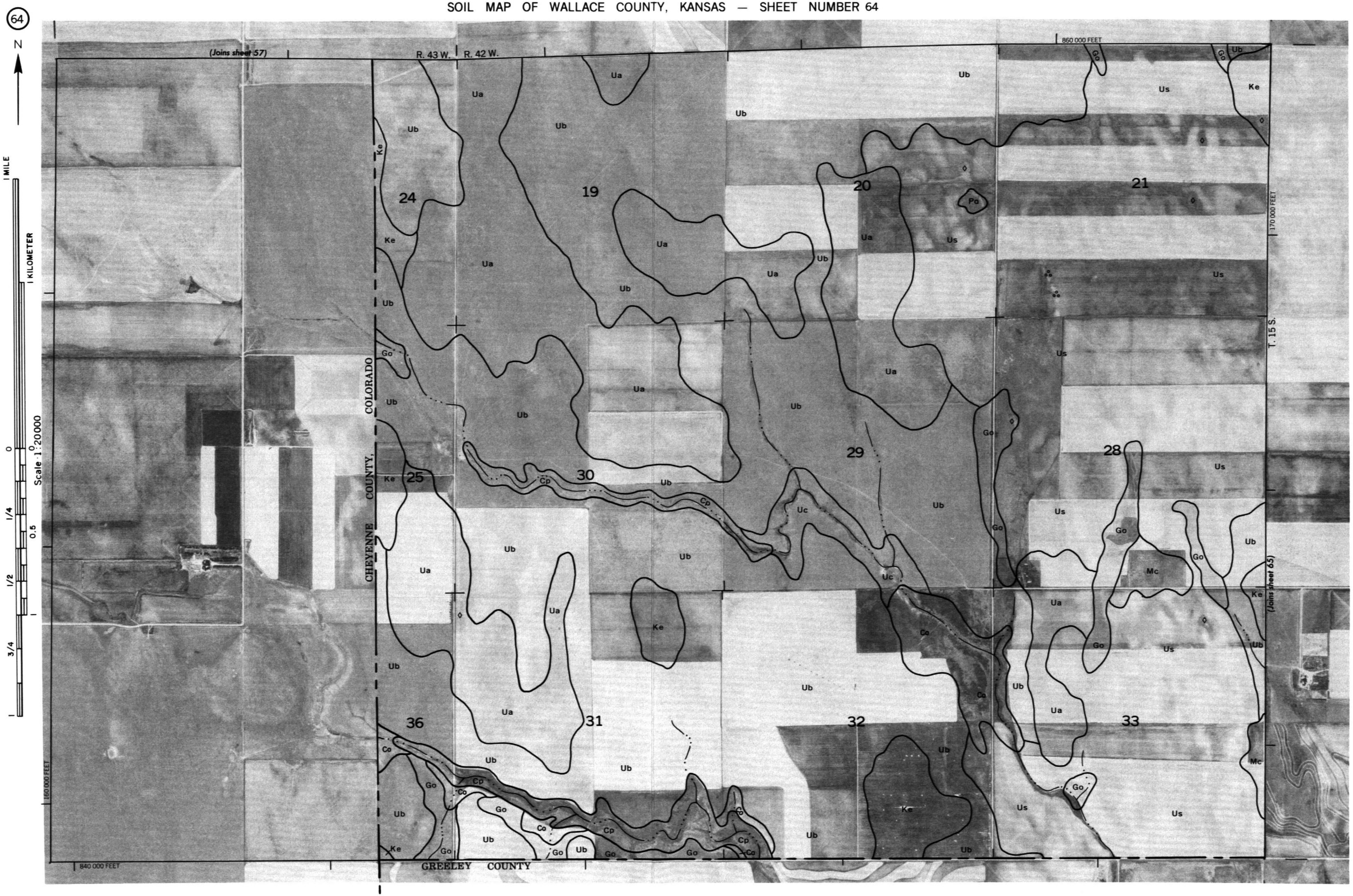
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 63



WALLACE COUNTY, KANSAS NO. 63

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 64



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

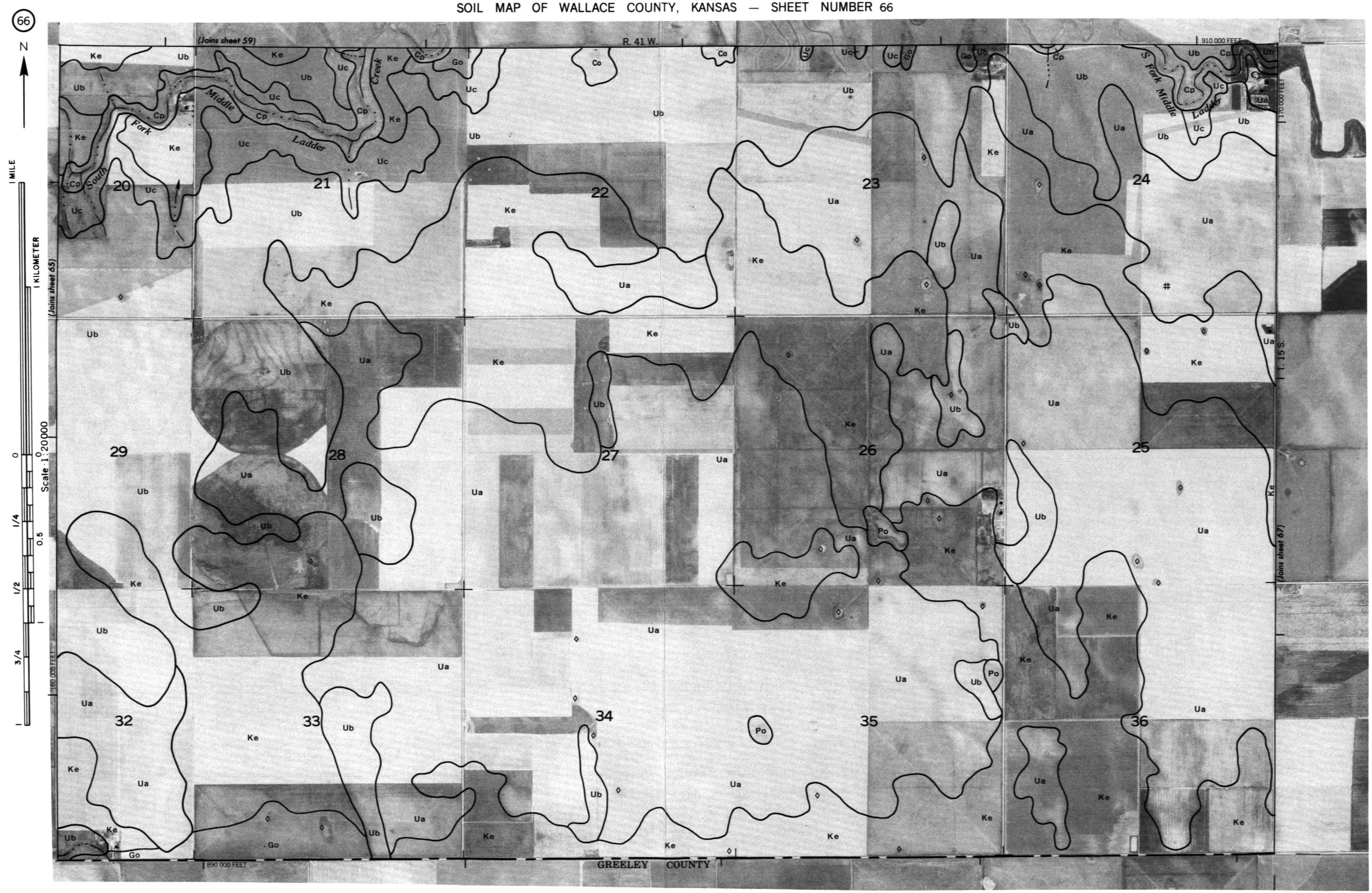
WALLACE COUNTY, KANSAS NO. 64

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 65

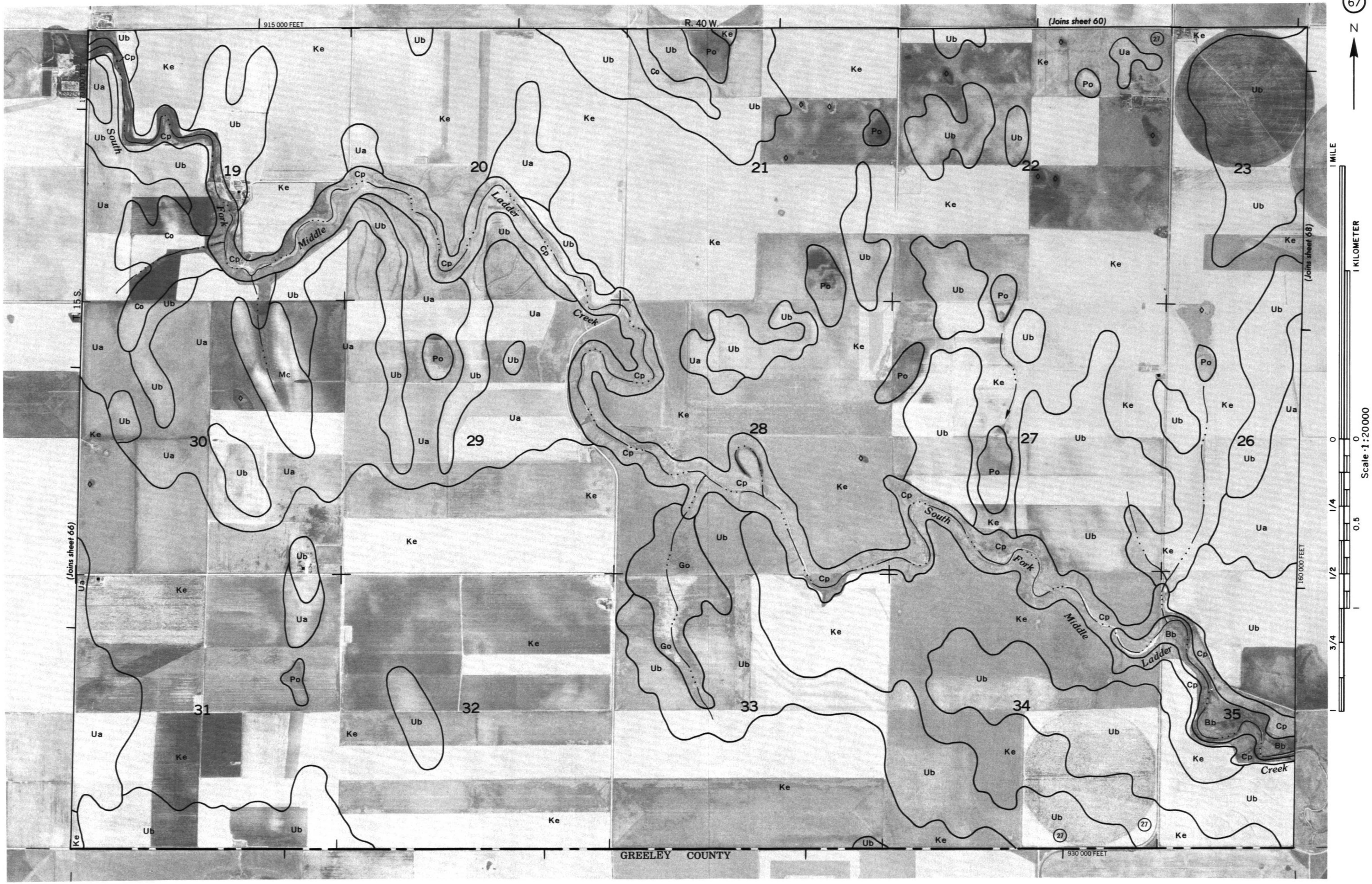
WALLACE COUNTY, KANSAS NO. 65

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 66



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

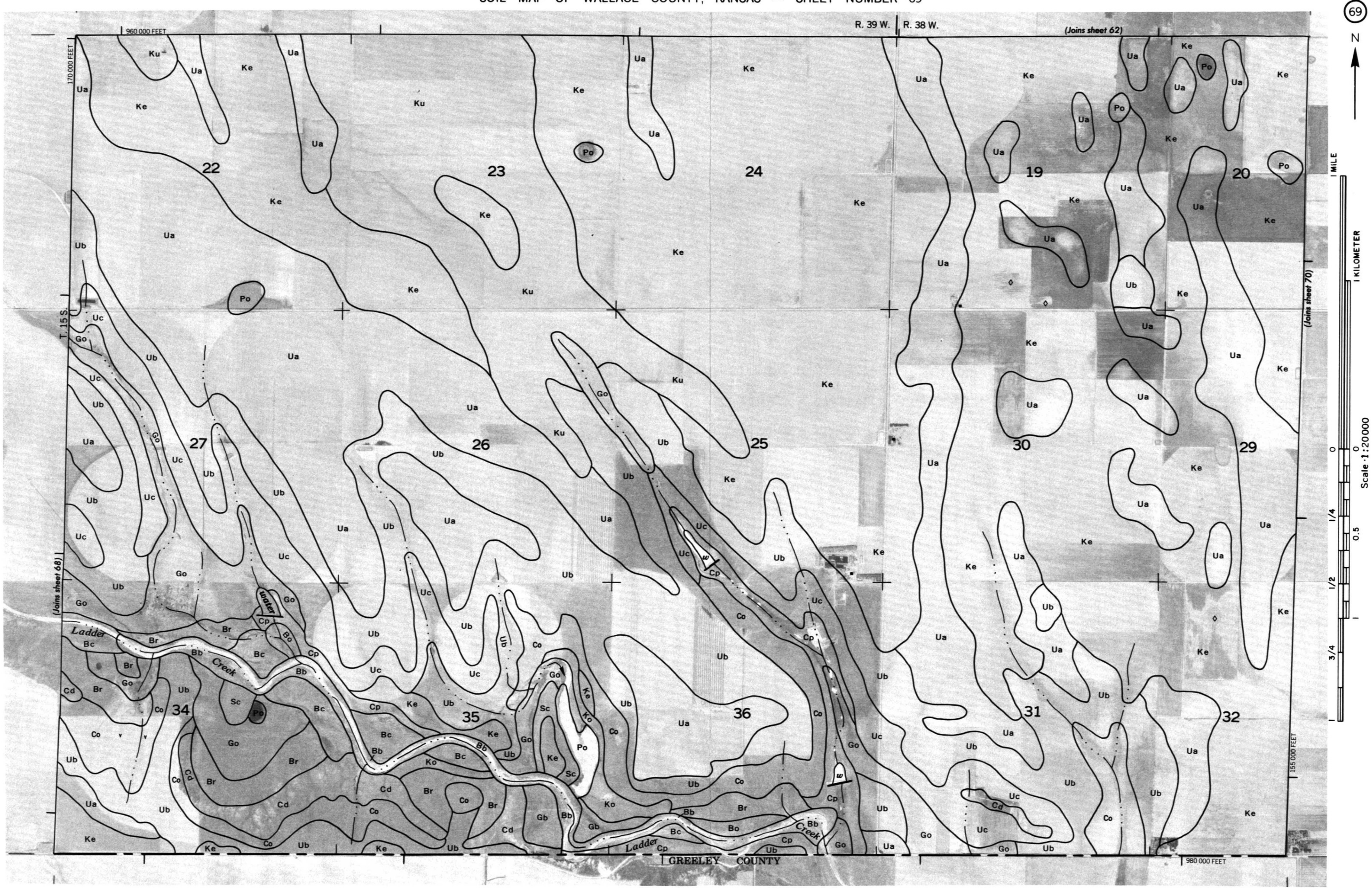


WALLACE COUNTY, KANSAS NO. 67

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

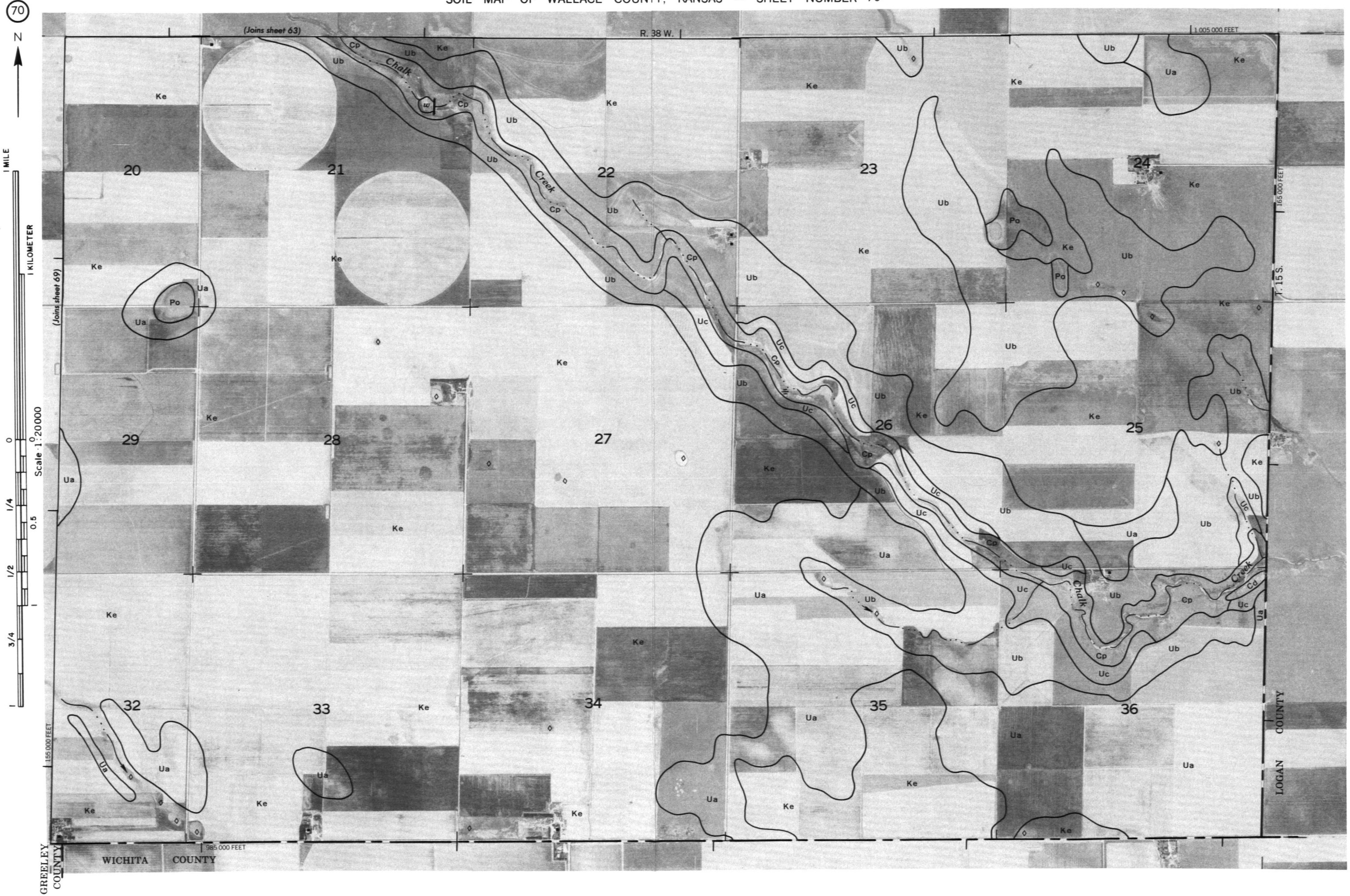
SOIL MAP OF WALLACE COUNTY, KANSAS — SHEET NUMBER 68

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



WALLACE COUNTY, KANSAS NO. 69

This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map is compiled on 1980 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.